Mosquito News

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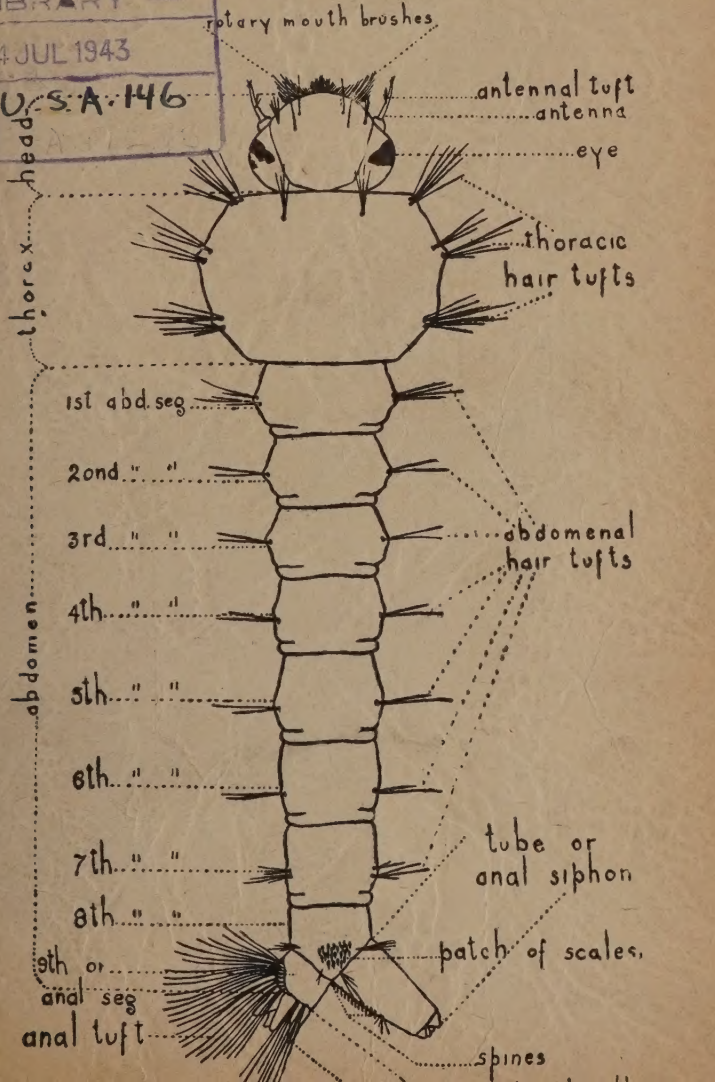

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Thomas D. Mulhern, Secretary-Treasurer

Eastern Ass'n of Mosquito Control Workers
New Brunswick, New Jersey

Dr. Thomas J. Headlee, scholar, teacher, investigator, organizer, mosquito fighter extraordinary, and scientist, was born at Headlee, Indiana, on February 13, 1877. A graduate of Indiana State University, he received his Master of Arts degree from the same school and his Doctor of Philosophy degree from Cornell University.

Coming to New Jersey in 1912 when mosquitoes were as yet uncontrolled and were interfering tremendously with the economic progress of the state, Dr. Headlee envisioned the vast improvement that would result from the elimination of the mosquito pest. As a scholarly entomologist he saw the great amount of effort that would be needed to successfully attack the problem, but he had the courage to approach it with determination and confidence. Building on a solid foundation of mosquito knowledge accumulated through the research of his predecessor at Rutgers, Dr. John B. Smith, he has devoted his unswerving energies to the increase of this fund of knowledge, the development and practical application of new methods and principles of mosquito control, and the dissemination of valuable information to mosquito fighters everywhere. He was called upon for guidance in the solution of wartime mosquito problems in New Jersey during World War I; now his teachings and his wise counsel are aiding mightily in the solution of the special mosquito problems arising from the present war.

Throughout the thirty years of his leadership in mosquito work, he has also made the insect problems of the farmer his own. Contemporary literature on economic entomology and mosquito control attest to the productivity of his research.

Dr. Headlee began the practice of his chosen profession at the New Hampshire Agricultural Experiment Station, where he served as assistant and associate entomologist in 1906 and 1907. From there he went to Kansas State College and Agricultural Experiment Station to become head of the Department of Entomology and Zoology, where he stayed until 1912. Since then, he has served New Jersey well as state entomologist at the New Jersey Agricultural Experiment Station and as professor of entomology at Rutgers University.

Believing always in the value of an organized approach to the solution of insect problems, he has held membership in many scientific and professional societies including the American Association for the Advancement of Science, the American Association of Economic Entomologists, and the Entomological Society of America, The Eastern Plant Board, The National Plant Board, and the New Jersey State Horticultural Society. He has received the honor of election to membership in the societies Phi Beta Kappa, Sigma Xi, and Alpha Zeta. He was one of the founders of the New Jersey Mosquito Extermination Association, of which he has been secretary since its establishment in 1914, and of the Eastern Association of Mosquito Control Workers, of which he was the first president (1935). He is one of those responsible for the beginning of publication of "Mosquito News" and he has given it his whole-hearted support.

While Dr. Headlee's writings have gained him renown among entomologists, it is his friendly leadership, his inspiration and encouragement that have won the high respect and affection not only of those mosquito workers who have been privileged to work in close association with him, but also of his students, fellow-scientists, and a wide range of co-workers.

May 1, 1943
Thomas D. Mulhern

EDITORIAL SECTION

EDITORIAL COMMENT

Just as our new chairman Jim Hart was getting organized to make this issue bigger and better than ever, he received his commission as First Lieutenant, Sanitary Corps of the Army of the United States together with orders to report to Fort Dix on May 7th. The Committee has had to struggle along without his valuable and encouraging assistance and has produced the issue as best it could under the circumstances. The Committee on Publications join with all who knew Jim Hart in wishing him the best of luck and success in his new work with the Army.

This issue represents a departure from the previous method of publishing in that it is now completely printed. Continued progress seems to mark each new issue and this step is probably the greatest stride of all because it will permit the inclusion of photographs and charts which could not be produced under the mimeographing process. For the immediate future at least, authors will be urged to furnish cuts of any photographs or drawings to be printed since the printing budget at present is not sufficient to cover the cost of making cuts.

Many favorable comments have been received on the value of the Suppliers' Directory printed in our March issue. Believing that such directories will be of service to mosquito control workers throughout the country, the Committee has included at the end of this issue a directory of mosquito control agencies and executives throughout the United States and many other countries. The job of accumulating and assembling the directory of mosquito control agencies was done by our Secretary-Treasurer, Mr. Mulhern. The Committee on Publications wishes to express its appreciation and thanks to Mr. Mulhern for the cooperation and effort in compiling this directory. Since the Committee felt that the directory on agencies would be more useful if the executives were also listed at the same time, the mosquito control executives have been listed under the agency that each represents. As a result there will be no listing of the mosquito control executives in the September issue as we suggested in March. A directory of mosquito control books and pamphlets is being compiled for the December issue.

THE EDITOR.

THE HUMAN SIDE OF MOSQUITO CONTROL

a news release by
J. DUNBAR ROSS
Chief Inspector & Secretary, Suffolk Cty. Mosq. Ext. Comm.
Yaphank, L. I., N. Y.

Most people think of mosquito control as a simple thing. It's just a case of going out and killing the larvae and that's all there is to it. It goes far beyond that. In a well regulated organization such as exists in many communities in this country the well informed executive and company worker must be capable of pitching in to many different duties. He

must be, to a certain extent, engineer, publicity director, employer and employee at the same time, complaint adjuster, chemist, photographer, mechanic, entomologist, inspector, navigator, title searcher and advertising expert.

The engineering problems which arise in mosquito control work are numerous, unusually interesting and sometimes complicated. In the first place vast systems of ditches must be laid out in the most economical and efficient way. These ditches are of varying width and must be deep enough to drain the water off the affected area and sometimes require digging to a considerable depth. Some trenches run for long distances and must be perfectly straight. The leads must be laid out in a regular pattern. After the construction work is carried out, each system must be laid out on paper giving the length and location of each and every ditch.

In addition to this there are other engineering problems which arise. Culverts often have to be lowered and exact grades are necessary. Tide gates and sluice boxes of various sizes have to be installed requiring expert knowledge of tidal conditions. Dams are constructed to insure the success of the tide gates. In many cases it has been found advisable to straighten and lower stream beds which requires a survey of the entire river to determine grades and courses. In some communities the dredging of good sized rivers has been resorted to in order to affect proper drainage of the adjacent country side. The question of filling in low areas often comes up with its problem of dikes, grades and where to get the material. There are many other engineering features of mosquito control work too numerous to mention.

In order to carry out all these engineering projects, machinery is required such as dredges, pumps, bull dozers and cranes. These are in addition to the regular fleet of trucks and tractors which must be kept in repair. Most Commissions maintain a fully equipped shop for the maintenance of rolling stock.

The publicity department of a Mosquito Commission is most important. This department deals in public relations. It puts the case of the Commission before the public. Publicity is given out in several ways. Lectures before Rotary Clubs, Chambers of Commerce, Women's clubs and other associations are very effective. These lectures are often accompanied by motion pictures showing the progress of the work. Another method used is to publish in the newspapers. The newspapers have been very cooperative in giving space and writing editorials to help the good work along. Annual reports are also helpful in furthering the understanding by the people of mosquito control problems. These reports represent a considerable amount of work, require careful editing and where cuts are used, the work often goes into photography and drafting.

Complaints must be handled quickly and diplomatically. It is often difficult to explain the presence of mosquitoes and care must be taken to satisfy the person making the complaint and at the same time not promise the impossible. Most complaints are about mosquito annoyance but some-

times they concern crickets, which have nothing to do with mosquito control.

There are many other lines of endeavor with which the mosquito worker must be familiar. He is not only employer but is also employee as he not only employs labor but in turn works for his Commission and is often required to sell governing bodies the idea of making appropriations. He must be somewhat of chemist in order to be able to mix the various larvacides and repellants. A large amount of inspection work is necessary and navigation of boats is often necessary. In some Commissions the law requires that the name and boundaries of all properties where work is to be performed be advertised. This requires laborious title searches.

One of the most important branches of mosquito control is entomology. Along the eastern seaboard, there are some forty different species of mosquitoes to be classified and studied. A competent entomologist must be able to quickly identify the adult and larva of each species. He must be able to state the habits, flying range and probably breeding place of each so as to guide the inspectors in looking for troublesome areas. In fact entomology is the core of the whole set up.

This article does not set out to claim that every mosquito worker must have detail knowledge of all these branches of control. Each Commission has its specialists who confine their work to their own department. But every executive should have a working knowledge of all of them and the other workers should be familiar with as many of them as possible as they are often called on to work outside their own particular department. Altogether the mosquito worker is a versatile person. He is engaged in useful and interesting work. We hope after reading this article that the general public will appreciate the effort its servants, in mosquito control work, are making to keep the citizens of their communities free from annoyance and disease.

BUSINESS OF EASTERN ASSOCIATION

NEWS OF THE ASSOCIATION

By THOMAS D. MULHERN, Sec.-Treas.

Historical

The Eastern Association of Mosquito Control Workers came into being in 1935, when the mosquito workers along the eastern seaboard from Massachusetts to Virginia felt the need of some means of exchanging ideas and promoting unity of thought and action within the group. Its operation has afforded its members frequent opportunities to get together to study problems of general concern, and to observe new methods and accomplishments of mosquito control agencies, thereby aiding its members materially in keeping abreast of new and important developments. From the founding of the association, there has been issued reports of the various activities, in order that the benefits accruing to the members might be of the greatest permanent value. Since 1941 "Mosquito News" has served this important function. Previous to that time, the reports were mimeographed and sent only to members.

Inspections

Each year there has been sponsored one or more inspections and meetings. These have been highly successful, and those who were able to attend have felt well repaid. Several of the field studies have taken the form of extended tours: for example, in 1938 ten days were spent in the Canal Zone, studying the methods and accomplishments of the mosquito control forces. This tour was conducted by Mr. W. H. W. Komp, and Dr. D. P. Curry, whose long experience in the Canal Zone and general acquaintance with the mosquito and health problems of the tropics resulted in a vivid portrayal of the conditions which existed in the early days, coupled with an impressive exhibit of the progress made through the years. This experience gives one an insight into the tremendous problem that must be facing the armed forces in the new tropic bases, and in the unsanitated areas about the older military areas. The Panama tour also provided an opportunity to see briefly some of the work being done in Havana.

Other extensive highlight tours have included a visit to the Savannah area and a detailed inspection of the Florida anti-mosquito work in 1939, and in 1941 an inspection of the work being done by the Tennessee Valley Authority. On this latter trip, the then new laboratory of United States Public Health Service was visited, the mosquito work of the City of Memphis was seen, and the group had the pleasure of attending a meeting of the famous Howard Krauss Society of South Side High School in Memphis.

Altogether, inspections have been as follows:

1936—Delaware and Delaware County, Pennsylvania.
1937—Massachusetts and Rhode Island.
1938—Panama and Havana—New Jersey.
1939—Savannah and Florida—Long Island and New York World's Fair—Northern New Jersey.
1940—Virginia and North Carolina including Dismal Swamp—Connecticut—Delaware—New York World's Fair.
1941—Northern New Jersey—Northern Delaware—Tennessee Valley and Memphis.
1942—Norfolk area of Virginia—Northern New Jersey.

There have been a number of business meetings, called as needed, in addition to the regular annual meetings, and there have been several special paper-reading sessions.

While it may be impracticable to schedule any extended tours in the immediate future because of war conditions, it seems more than ever necessary to hold frequent get-together sessions for the discussion of war-made problems, and it will probably be feasible to work out short inspections. When the Victory is won, however, there will doubtlessly be opportunity for extremely valuable studies of the new work that has had to be done to insure the successful prosecution of war activities,

possibly in Central or South America and the island bases, certainly in the Southern United States.

Mosquito News

A forward step of high importance was the beginning of publication of "Mosquito News." The first number of this quarterly periodical was issued as a mimeographed news letter, but the membership immediately recognized its potential value as a journal and demanded that it be issued in booklet form for permanence. Now going into its third year, it has been enthusiastically received and there is an increasing demand for it, as well as for membership, by mosquito workers outside the area originally served by the association. The association is now, in fact, a national association, for it has members and subscribers from California, Oregon, Utah, Texas, Missouri, Mississippi, Louisiana, Alabama, Tennessee, Florida, Kansas, Illinois, Georgia, North Carolina, Virginia, Maryland, Delaware, New Jersey, Pennsylvania, New York, Connecticut, Rhode Island, Massachusetts, and New Hampshire. "Mosquito News" has attempted to serve the evident need for a journal of mosquito work for mosquito workers, broadening its scope and policy as necessary. The extent of its service to mosquito work, especially during the war, will be limited only by the participation and cooperation of all of us in submitting for the consideration of the publication's committee news items of general interest and mutual benefit. It is gratifying indeed to find the new members as well as the older ones sending in data, for this is an indication that they are at once considering the "News" their own journal.

March 1943 Meeting

A meeting was held at Absecon, N. J. on March 11, and given over principally to a discussion of the expansion of "Mosquito News" and the association. Fortunately, the publication has been able to completely avoid competing with the other journals of interest to mosquito men, for it fills a field not heretofore covered by any journal. In fact, it is supplementary to the other periodicals, and in it will be found frequent references and abstracts directing attention to the other publications and to other organizations. In this manner "Mosquito News" continues to promote unity among mosquito workers.

A question that has been occupying the attention of the officers, committees, and members of the present Eastern Association is whether the organization should be modified to better fullfil the demand for national service. Several suggestions have been made, the most practicable of which seem to be, first, that the association change its name to indicate its national character, to make the publication of "Mosquito News" its primary objective, and to try to secure as members all of the active mosquito workers in the country, and second, that a subsidiary group be formed, to affiliate with all the mosquito control groups in the country, the sole purpose of such group to be the publication of "Mosquito News." The Eastern Association would then restrict its activities to that of a sectional group.

Financial considerations demand that the publication continue

through 1943 on the present basis. However, it should be possible to put through whatever changes are desirable by the beginning of 1944, and a special committee was appointed to consider all aspects of the question and to draft recommendations including constitutional changes to be referred to the Executive Committee, and subsequently to the general membership after action by the above committee. The members should at this time feel free to express their ideas on the subject so they may be considered previous to the taking of any action.

Other committees have been appointed as follows:

Membership:
- Dr. R. Glasgow (N.Y.), Chair.
- Dr. T. J. Headlee (N.J.)
- Mr. H. Fellton (U.S. Govt.—Ga.)

Meetings and Inspections:
- Mr. P. Ruth (Va.), Chair.
- Mr. L. Smith (N.J.)
- Mr. R. Sammis (N.Y.)

Mosquito News:

Editorial Board:
- Mr. J. Hart (N.J.), Chair.
- Mr. C. Williamson (N.Y.)
- Mr. H. H. Stage (U.S. Govt.—Wash.)

Sectional Representatives:
- Mr. H. F. Gray (Calif.)
- Mr. J. L. Clarke (Ill.)
- Mr. G. Bradley (U.S. Govt.—Ga.)

WORLD-WIDE MOSQUITO CONTROL

SPECIES SANITATION AND NATURALISTIC METHODS OF CONTROL OF MOSQUITOES

by
Harold Farnsworth Gray, Gr. P.H.
Berkeley, California

A Talk given to the Officers and Men at Moffatt Field, December 17, 1942

INTRODUCTION

Practically every medical man knows there are about 1700 species of mosquitoes, of which about 170 are **Anopheles** (malaria transmitters). Every one knows that mosquitoes breed in water, usually standing water, and that if we get rid of the water, or can kill the mosquito larvae in the water, we can eliminate mosquitoes. These are elementary statements, but beyond these ABC's there is a considerable body of techniques relating to just the usual methods of mosquito control by the processes of drainage, filling and pumping, and of larviciding by means of petroleum derivative oils, Paris green and pyrethrum extracts.

A certain amount of entomological knowledge, engineering skill and practical experience are necessary to effectively apply the foregoing methods. But there are many places in the world, especially in the tropics, where these usual methods of mosquito control are only partially applicable, or cannot be effectively used because of cost limitations, scarcity of equipment or materials, climatic conditions or other factors, and other methods, developed from our ecological study of mosquito species, may be more simple, less expensive and reasonably effective.

A number of such methods, because they are directed usually to making some minor change in the environment so that unfavorable instead of favorable natural conditions occur with relation to a particular mosquito species, are termed "naturalistic" methods of mosquito control.

You will note that I said "naturalistic" control methods are directed at a particular species of mosquitoes. This ties into another rather modern concept in mosquito control, that of "species sanitation." The idea of "species sanitation" was undoubtedly developed by Sir Malcolm Watson in Malaya, but the term, or its Dutch equivalent, was coined by Swellengrebel.

Let us limit our discussion of these two concepts principally to the control of malaria, in order to keep within a reasonable compass of time.

There are 170 species of **Anopheles** in the world, of which probably all are capable of transmitting malaria. But not more than about 47 species and subspecies are of any appreciable importance as malaria transmitters, and of these probably only about 20 or 25 species and sub-species are of great importance.

Years ago Watson discovered the very important fact that in any area where malaria is prevalent, usually only one, or at the most two or three species or subspecies of **Anopheles** are concerned in the transmission of the disease, and therefore if effective control methods are applied to this species the disease can be very greatly reduced in that area at minimum expense. For malaria control, the reduction of the very few (usually only one) vector species will produce good results, even though other Anophelines and Culicine mosquitoes still are abundant, in that area.

Of course in some areas, particularly tropical areas, concentration on the vector **Anopheles** for that area will not usually minimize the great numbers of pest (non-vector) mosquitoes, and there may also be a problem of other mosquito-transmitted diseases such as yellow fever, dengue or filariasis. But the vectors of these diseases are a few specific mosquito species, against which a particular form of species sanitation will be applicable, so that, for our illustrations, we will stick to malaria control.

Medical officers are concerned principally with the control of disease, where fore their interest will be served by species sanitation, a concept which is in accord with the military maxim of economy of effort.

SPECIES SANITATION

For illustrations of species sanitation let us take a few regions throughout the world and call attention to the principal malaria vectors there.

1. Many of you come from the Mississippi Valley, or the Southeastern states, where a single species of mosquito, **Anopheles quadrimaculatus,** is the effective vector of malaria. Successfully control this one species in that area, and malaria no longer will be endemic, though there are other **Anopheles** present which can, but seldom do, transmit the disease.

2. But in the Pacific Coast States, a mosquito which looks much like **Anopheles quadrimaculatus,** but has entirely different breeding habits, is the effective vector of malaria. This is **Anopheles maculipennis freeborni,** which breeds in shallow seepage water especially from irrigation, whereas **A. quadrimaculatus** is typically a pond or reservoir breeder. The control of malaria in the Pacific Coast Valleys almost entirely depends on the control of **A. maculipennis freeborni.** The control methods which are successful against **Anopheles quadrimaculatus** would fail against **Anopheles maculipennis freeborni,** and vice versa.

3. Some of you may be stationed in the Solomon Islands, or New Guinea or the Molucca Islands, or North Queensland. Here the principal vector of malaria is **Anopheles punctulatus,** which is also found in New Britain and New Hebrides, along with its sub-species, **A. punctulatus moluccensia.** The first species is usually limited in its breeding places to natural swamps, pools, and puddles of stagnant water. But its variety **moluccensis** is one of the most versatile breeders among Anophelines, and apparently will breed in almost any kind of water, fresh or brackish or salt, clean or dirty, running or stagnant, in natural collections or in artificial containers. Where you have **A. punctulatus moluccensis** to deal with, you have a formidable job on your hands, for you may have to attack and control

all water within a reasonable distance from your post. In controlling **A. punctulatus moluccensis** the idea of species sanitation is negatived more or less, as in controlling that species you probably must, of necessity, control practically all other species of mosquito in its area. However, practical experience with this species during this war may modify our views and perhaps bring about some simplifications in control of this species.

4. Probably the principal vector of malaria in the Philippine Islands, at least on Luzon, is **Anopheles minimus flavirostris,** a mosquito which breeds in running water in streams and ditches. The usual methods of mosquito control, directed againts standing water, fail completely to control malaria where this mosquito is the vector, as on Bataan Peninsula.

In 1898 when we first went to the Philippines, our Army medical officers had been taught to look upon marshes as malarious, and they regarded the lowlands, especially in the vicinity of Manila, for example, as extremely dangerous to troops. Actually there was a low incidence of malaria in and about Manila, where the dominant anopheline, **A. ludlowi,** is a poor vector under natural conditions; but the rigidly held idea that "marshes equal malaria" led to the stationing of troops as much as possible in the hill areas near running water. Malaria promptly became a scourge among troops and civilians so situated, while the disease remained at a low rate of incidence among troops and civilians quartered of necessity in the supposedly malarious lowlands. A report by Crosby and Whitmore in 1904, buried in the medical records of Fort Stotsenburg and long neglected, showed that the stream-breeding **Anopheles minimus flavirostris** of the hill areas was an important vector, in fact the vector, of malaria in Luzon. But it took twenty-one years (to 1925) for this information to be acted upon, even though Walker and Barber in 1914 had again showed that the stream-breeding **A. minimus flavirostris** was the dangerous vector. And in view of our recent heavy losses on Bataan Peninsula, due in large part to malaria, I can perhaps be pardoned a certain skepticism as to whether our available knowledge was adequately acted upon.

5. Many years before the relationship between **Anopheles** and malaria was known, the Italians had recognized that a mixture of salt water and fresh water on the marshes along the Italian coast resulted in intense malaria. An Italian engineer named Zendrini therefore in 1740 constructed control gates on the marshes near Viereggio to keep out the salt water from tides, with the result that these marshes and their vicinity have been healthy ever since. Zendrini's gates were still operating at last reports.

The reason for this we now know. Malaria in this part of Italy is transmitted by **Anopheles sacharovi** and **Anopheles maculipennis labranchiae,** which are brackish water breeders. When the salt water was excluded by Zendrini's gates, the conditions became unfavorable for these two vector species, and they were supplanted by fresh water **Anophelines,** such as **Anopheles maculipennis messeae** and **Anopheles maculipennis maculipennis,** which are not normally vectors of malaria in Italy, though they are usually vectors in Southern Russia.

6. As a final illustration we may mention Malaya, where Watson discovered that a selective attack against **Anopheles umbrosus** in the lowland swamp areas was necessary for malaria control, but that in the hill areas the species which must be controlled was the stream-breeding, sunlight-loving **Anopheles maculatus.**

The foregoing illustrations serve sufficiently to illustrate the fact that in any area the attack upon mosquitoes, for successful malaria control, must be made upon the principal vector species in that area. This means also that we must understand the ecology of this principal species, and use as control measures those which are effective against that particular species. This, for economy of effort, we would like to do at a minimum expenditure of labor and materials, and this can frequently be accomplished with a relatively minor change in environmental conditions, which will make the area unsuitable to the breeding of the vector species in that area. Let us therefore discuss some of these changes which we term "naturalistic methods."

NATURALISTIC METHODS

1. Changing Saline Content of Breeding Water

One of the simplest methods of naturalistic control is to change the salt content of the breeding water. Many species of mosquitoes are limited in breeding to water of a certain salt content, and above or below that content they will not breed in appreciable numbers. Many examples can be given, but three will be presented.

(a) The brackish marshes at Durazzo, Albania, formerly bred millions of **Anopheles sacharovi,** a dangerous malaria vector. Hackett had this marsh enclosed on the shore side by a dyke, and installed automatic gates which would permit salt water from the Adriatic Sea to flow in at high tides, thus increasing the salt content above the tolerance for **A. sacharovi,** and so practically eliminating malaria in this area.

(b) Walch in Java eliminated the breeding of **Anopheles sundaicus** in the native food-fish (**Chanos** species, called "bandeng" by the natives) ponds along the coast by similarly increasing the salinity of the water in the ponds, but paradoxically the breeding of this same species in the coastal mangrove swamps at Malaya can be controlled by freshening the swamp water.

(c) I have previously referred to the control of **Anopheles sacharovi** and **Anopheles maculipennis labranchiae** at Viareggio in Italy by excluding salt water from the marshes. The Dutch have also found that when new polders are reclaimed from the sea, at first the dangerous vector **Anopheles maculipennis atroparvus** breeds profusely, but later, when the polders have become freshened, **atroparvus** is supplanted by the relatively harmless **Anopheles maculipennis messeae,** which appears to be able to overbreed **atroparvus** in fresh water.

2. Flushing

Some of the most dangerous tropical vectors of malaria breed in running water, for example **Anopheles maculatus** in Malaya, and **Anopheles minimus flavirostris** in Luzon or **Anopheles minimus** in India; or they are stream-bed pool breeders, such as **Anopheles culicifacies** in Ceylon.

The latter species can be controlled by channelizing the stream so as to eliminate the pools, and some workers have been quite ingenious in devising simple methods of making the stream itself do the work of channelizing the center of the stream bed while silting up the side pools. These stream-bed pool breeders can also be controlled by oiling, but at much greater ultimate cost.

But for the species actually breeding in running water the usual control methods are either inapplicable, ineffective or out of the question because of cost, and new methods had to be devised. K. B. Williamson at Cameron Highlands in Malaya is credited by Watson with having successfully developed in 1930-32 the method of automatically flushing streams to destroy the larvae of **Anopheles maculatus,** though both Le Prince at Panama and Ronald Ross at Ismalia are known to have used hand-controlled gates for flushing early in this century.

Flushing is performed by building a small dam (a few feet high) across the stream bed, and placing in it a device which will permit a large quantity of water to be stored above the dam, and then be discharged suddenly down stream. The control apparatus may be either a hand-operated sluice gate, or an automatic device such as a tipping bucket or a siphon.

In Malaya, thousands of natives have been taught to control malaria on their land by means of inexpensive hand-operated sluice gates, and many have also built control structures of the inexpensive tipping-bucket type. In Penang J. S. DeVillers has successfully developed an automatic siphon for the flushing device, and this idea has been extended by G. Macdonald in Ceylon to a standard concrete siphon fabricated in sections at a central plant and quickly and easily assembled where required.

In practice, the action of the sluice, either automatic or hand-operated, causes a large quantity of water to flow suddenly down the stream bed, flushing all mosquito larvae and pupae out, and killing many if not most of them, either by bruising them by dashing against the sides and bottom of the stream, or by the dynamic effect of the water in disrupting their bodies. Not only are the larvae

cleared out of the stream bed for distances of from several hundred yards up to a mile or more below the dam (depending upon the slope of the stream bed and the volume of the flush), but the fluctuations in water level in the ponded reach above the dam also tends to discourage mosquito breeding, and probably most of the few larvae to be found above the dam will be either left stranded on the sides, or swept out with the flush.

Obviously this general device can be used successfully and extensively in many tropical areas. Watson and others report that it is used widely in Malaya, and its use in India is being rapidly increased. When we get back to the Philippines, we should use this method very extensively wherever applicable.

I quote the following from pages 4, 5 and 6 of a pamphlet published in May, 1942 by the Ross Institute of Tropical Hygiene (London School of Hygiene and Tropical Medicine), entitled "Some Emergency Anti-Malarial Measures," and written by Sir Malcolm Watson.

"On the western side of South India the malarial season is the pre-monsoon period, when the rivers are running at a slow speed, and are not flushed by rain storms. Once the monsoon breaks there is no need for any mosquito control of the streams. On a number of estates which I visited I saw a very simple way of sluicing the streams. It consisted of an earth dam with one or more oil drums, the ends of which had been removed, to form openings through the dam for releasing the flush. The upper end of the oil drum was closed by a sheet of wood until the dam was full. Then the wood was removed by hand and the stream was flushed. On one estate there were 60 of these dams across various streams, the largest of which was about 20 feet wide. The dams were operated in succession, beginning at the top. The fall in the malaria as the result of this simple procedure was remarkable indeed. The largest of these dams cost three rupees for labour. When the monsoon broke all the dams were swept away, but to replace them at the end of the rains cost only 60 rupees. Except for the wages of the two or three men who operated the sluices this was practically the whole cost of the control of malaria on this estate for the year. Nothing would have been gained by erecting concrete dams; they would have been merely so many obstructions during the torrential rains of the Western Ghats.

"In South India I also saw many simple sluices made of wood, where the gate was lifted by hand out of the slit which held it. These, too, were in earth dams, which were washed away when the floods came. The sluice gate was saved by being tethered to the bank by a wire. It is important that the sluices are water-tight, otherwise in drought not enough water is collected to flush the stream. It is also important that the flush should not exceed the amount of water in normal wet weather. If it does the banks of the stream are eroded. The quantity of water released depends on the size of the openings in the dam and capacity of the reservoir.

"There were also very effective concrete dams, which flushed rocky streams 20 feet wide for fully a mile. The length flushed depended on the nature of the stream bed. Where the gradient was flat, and the bed full of large boulders, the flush was effective for a short distance. The sites of the dams should be the end of the flatter portions of the stream bed. In this position the dams will hold the maximum amount of water, and so will be most effective. Where, after flushing, larvae are found lower down in a stream it indicates that another dam should be erected. Before building permanent dams it might be wiser in some places to begin with temporary earth dams. These would be a guide to the best sites for the dams, to the required capacity of the dams, and the results likely to be obtained by sluicing. At one place where the river had an unusual number of obstructions and the desired results were not obtained, a special procedure was adopted. The gate was opened, and the dam half emptied. Then the gate was closed, the dam oiled, and after a short time the gate was reopened and the oiled water rushed down. This was effective in removing larvae which previously managed to maintain themselves in this very rough stream bed.

"In Assam, in Northern India, Mr. Lloyd, a tea planter, was, if my memory is correct, the first to use sluicing. He erected a series of dams in a ravine about

40 feet wide. The openings were controlled by sluices. What was a dangerous valley from the many seepages in its bed was effectively controlled by the dams and the sluicing.

"Many new dams are now being erected in Northern India, in which an automatic sluice is incorporated in the concrete, like those designed by Dr. McDonald for Ceylon. But instead of a flush of 475 gallons per minute from each syphon, some sluices are designed to deliver four times this quantity of water. They have to be constructed on the site, as the various pieces are too large to be cast at a central spot, as in Ceylon. But despite this want of mass production, they cost much less than a battery of the Ceylon type which would deliver the same amount of water. Another difference, as the result of the experience in Ceylon, is the incorporation of a hand-operated sluice gate in the dam, as well as the automatic syphon. This allows the debris and silt, which has collected in the dam, to be scoured out during heavy rains. It will probably be wise to incorporate a hand-operated sluice in all dams, along with automatic syphons; so that if in a partial drought there was not enough water in the dam to operate the automatic sluices often enough, the stream might still be kept harmless by opening the hand sluices."

3. Fouling and Stagnating

One of the things that is noticeable about most species of **Anopheles** is their preference for comparatively clean water. The most important exception presently in mind is **Anopheles punctulatus moluccensis** in New Britain and New Hebrides, and perhaps elsewhere, which will breed in foul water. It therefore is possible to discourage the breeding of most species of **Anopheles** by purposely fouling their available water with rotting vegetation or other organic matter, such as sewage, garbage or other wastes. True, this may make possible an increased breeding of certain Culicine species, and result in much discomfort, but where other methods are either not available, or too costly to apply, or are ineffective, there seems to be no reason why the method of deliberately fouling the breeding water should not be used effectively. Native labor could be used to cut large quantities of vegetation and pack it into breeding waters, to ferment and foul the water.

Where there is a shortage of anti-larval oil, such as Diesel oil, or of larvicides such as Paris green or pyrethrum, the method of fouling certainly ought to be used as a substitute method, and in addition I feel that it ought to be tried out extensively in the tropics as an anti-anopheles control method, even if you also treat the fouled pools with oil from time to time to minimize the breeding of pest mosquitoes of the Culicine group.

I will here quote certain pertinent remarks by Sir Malcolm Watson regarding the use of oil. They are quoted from a paper entitled "Some Points in the Technique of the Prevention of Malaria," and published in 1938 in the Journal of the Ceylon Branch of the British Medical Association. Watson is quoted for the reason that he was the originator of successful malaria control in the Far Eastern tropics (Klang and Port Swettenham in Malaya in 1901), and has had the longest and most successful experience of any living man in the effective control of malaria in the tropics.

"This was the discovery of a perfect anti-malarial mixture. It proved of incalculable value to Malaya. I am thinking in terms of tens of thousands of lives and hundreds of thousands of pounds. Its use rapidly spread all over the Peninsula, and today there is, I believe, a far greater amount of oil used per head of the population in Malaya than in any other part of the tropical world. Government in Malaya uses it extensively, and encourages its use by carrying oil on the railway at the lowest rates, as some other Governments are also doing at the suggestion of the Ross Institute. One of the great advantages of oil is that within a few days, every larva in an area can be destroyed, a large number of adults returning to lay their eggs also are destroyed, and those that do not alight on the oil have to travel outside the oiled area, at least half a mile from a house before they find congenial and clean breeding places. It means that if a female of a species is laying her eggs every three days, she has to travel backwards and forwards several miles in the ten days before the parasites have developed to the state of being sporozoites in her salivary glands. Only when this stage is reached can she infect when she bites. Obviously every mile she has to travel

reduces her chance of getting in a bite that can infect. In practice, when oiling has been properly done on a weekly round, malaria drops very rapidly, and within less than three months only relapses are found on an estate, and not so many of them. Spleen rates, admission rates and death rates fall with an almost startling rapidity even on the most intensely malarial places. These results are to be seen not only in Malaya, but also in India and Africa. The area usually oiled is half-a-mile round the inhabited area; it is possible that in very special conditions, a somewhat larger protective area is required, but these are very special conditions.

"Any oil or mixture of oils will not give this result. We soon found that what is sold as 'crude oil,' or 'fuel oil,' or 'diesel oil' varies greatly in composition in different parts of the world; and that many of these oils do not make satisfactory anti-malarial mixtures. Some would not kill larvae, some would not kill grass, some would not spread, some required admixture with uneconomical amounts of kerosene, and some were quite useless.

"I would like to give a warning against using home made mixtures of old engine oils. These vary in composition and some are useless. It may well prove to be false economy to use oils which have not been tested to see if they are effective larvicides.

"The Health Officers of one Government, who could draw large supplies of used aeroplane oil for anti-malarial purposes, found even this so unreliable that each sample had to be tested before it could be used, and owing to the results being so variable they gave up using the aeroplane oil."

4. Shading and Clearing

There are perhaps a dozen or more of these naturalistic methods of mosquito control, but I shall select only one more for discussion. For the other methods, those especially interested can find descriptions in the book on "Mosquito Control" published in 1940 by Professor W. B. Herms and myself.

This last method is the matter of clearing areas in which mosquitoes breed. In many anti-mosquito campaigns one of the measures used has been the clearing of dense vegetation in jungles, swamps and along stream beds. Sometimes this was done merely to permit easy access for the application of other control measures, such as drainage or oiling; in other cases it was done to facilitate the drying up of wet areas; and in other cases it was just done because somebody else had done it elsewhere.

Against some species of **Anopheles**, such as **A. umbrosus**, which is a shade-loving species, clearing is a useful procedure, though usually relatively expensive. But against such sunlight-loving species as **Anopheles minimus** in India, or **Anopheles maculatus** in Malaya, and probably against **Anopheles pseudopunctipennis** in Argentina, clearing is not only useless, it is highly dangerous. The British found this out years ago in Malaya. When they began work in the hill regions, they cleared the small streams, following out their customary procedures in the coastal lowlands. But when they did this the malaria became epidemic in severe form, as they thus made possible the great proliferation of **Anopheles maculatus**, which thrives best in sunlight. Now they leave as much shade as possible along the streams, and in India, against **Anopheles minimus** they plant hedges of **lantana, dharanta** and other bushes along their streams, ditches and drains so as to effectively shade the water surface. In some cases they have made mats of split bamboo or other materials and covered the water surface with these mats.

Rather obviously, therefore, clearing should **not** be adopted where there is any danger that a sunlight-loving vector **Anopheles** would be encouraged to increase its breeding, and furthermore, clearing may be interdicted by military conditions requiring maximum concealment. But shading, if carefully done, may not interfere with military concealment, and may be very helpful as a deterrent to the breeding of certain dangerous vector **Anopheles** in a particular area. But be sure you know what species are present, what species is the primary malarial vector, and what its breeding preferences are with respect to shade or sunlight, before you change the landscape.

I quote again from Watson, in an article entitled "Prevention of Malaria in

India," published June 8, 1940 in "Nature."

"For example, on many estates in India, as in Delhi, much malaria has been 'man-made.' Over wide areas of both northern and southern India, the malaria is entirely due to man interfering with Nature by his clearing away jungle from streams and exposing them to the sunshine, and by his draining swamps. For by doing so he has driven out the jungle-loving or harmless species and permitted the breeding of dangerous species—A. minimus in the north, A. fluviatilis or A. culicifacies at different elevations in the south. Intermittent flushing will wreck the home of even the fastest stream-breeding malaria-carrier in the world; it is much used in India. Streams are flushed by hand-operated openings in simple earth dams; by automatic tippers, costing a shilling or less, of a design that would rejoice the heart of Mr. Heath Robinson; or by more elaborate things of concrete and iron. In other places, if man holds his hand, Nature will cover up her wounds with secondary jungle, but often she is too slow and we must replant appropriate shade. So we see the strange sight of hundreds of acres of little squares of almost stagnant water growing rice in the sunshine, and down the center of the rice fields a stream densely shaded by a hedge; it may be of the lovely shoe flower (Hibiscus), the wild rhododendron (Melastoma), the notorious Lantana or other plants. The center stream alone was the danger. The hedge has made it harmless, and an intense source of malaria has been eliminated. There are 2,000 miles of these dense hedges now, and 4,000 miles will be effective by the end of the year."

5. Pole or Faggot Drains

There will probably occur a number of situations at or in the vicinity of stations which will be occupied for considerable periods of time (perhaps for the duration of the war) and where sub-surface drainage would be a very helpful Anopheles control method. However, neither vitrified clay tile, or concrete drain tile, or perforated corrugated metal pipe, or even gravel or crushed rock, may be available to construct such drains.

Under these conditions it is possible to construct sub-surface drains which will work effectively for years, using native materials which are readily available at the site. The best are bamboo poles laid in the trench in such a manner that the longitudinal interstices between the poles forms the channel through which the water can flow. Three, six, or ten poles, tied at intervals of about two feet, can be used in the bottom of the trench, and covered with a few inches thickness of any coarse twigs, small brush, etc., to prevent packing of dirt into the spaces between the poles.

If bamboo is not available, then any green wood poles (saplings) of two or three inches diameter will do. And even if no poles are available, the bottom of the trench can be filled for a depth of one or two feet with cut brush, and a fairly useful drain obtained.

Conclusion

In this somewhat sketchy manner I have tried to give you some idea of a few of the newer concepts in the field of malaria control by anti-anopheles methods.

We are not going to be able to carry on successful military operations in tropical areas unless we use intelligently and effectively the various Anopheles control measures which are applicable to the conditions in a particular area. Do not be deceived—drugs are not effective as malaria control agents. For the reason that he has had the longest and most successful experience of any man in controlling malaria in tropical countries, I quote Sir Malcolm Watson again on this point:

"I want to stress that while drugs can cure malaria, no drug so far known can prevent infection. While there are hundreds of places in which malaria has been abolished by the destruction of mosquitoes, there is no example of a place in the tropics being freed from malaria by the means of drugs alone. The use of quinine can never result in the abolition of malaria, or even make any material reduction in the liability to infection in a malarious locality. Extensive experiments with the new drugs atebrin and plasmoquin have led to the same conclusions."

This does not mean that Watson denies the applicability of anti-malaria drugs

in malaria control. Here again his experience is probably the longest and most complete of all living men. I quote from his Finlayson Memorial Lecture at Glasgow in 1934:

"From no place, however, were results reported from quinine comparable with those obtained by attacking the mosquito, as at Klang, Ismalia and Panama. In Malaya, where we were faced with the most intense malaria, and could afford to neglect no measure which could be of any help, however slight, prevention by quinine was given a trial, not merely for a time, but the drug was used on a large scale for many years, after we had defined its value and its limitation. Our first efforts with the drug in 1904-1905 were definitely encouraging, but in 1906 when larger numbers of non-immune labourers arrived in the country, it was found necessary to raise the daily dose to 10 grains for adults, but even this did not prevent them becoming infected, and dying at a rate which caused grave anxiety. The conclusions I reached then were described in the first edition of my **Prevention of Malaria.** 'The true action of quinine appears to be to assist the human host in working out for himself the resistant power which will ultimately free him from the disease. It acts either by attenuating the virus within the host, or by increasing the resisting power of the host in some unknown way, or possibly by both. Without quinine in many cases, especially in very unhealthy spots, the human host would die before he had acquired his resistant powers. We thus see that, if quinine in sufficient doses be given, the man will gradually overcome the parasites, and apparently suffer little from them; but at the same time we see that during this period he is capable of infecting others. The man is for a time a "malarial carrier" not unlike the typhoid carrier.'

"There is, in my opinion, no antagonism and no competition between the various methods of preventing malaria. The wise sanitarian will use those which give him the maximum benefit for the minimum expenditure. In all campaigns anti-malarial drugs have a place. In tropical regions where malaria is intense drugs must be used to cure rather than with the idea that they will prevent infection; indeed, without drugs little headway might be made with other methods, and valuable lives might be lost in many campaigns."

There is no question but what under combat conditions in the tropical regions we will have to rely partly on the use of drugs to control the manifestations of malaria infection in personnel, and partly on a direct attack on adult anophelines in tents and barracks, either by hand catching or by pyrethrum sprys. But as the supply of quinine is quite limited, and much of our former sources of pyrethrum cut off, we should endeavor to make their use unnecessary as rapidly as possible, and this can only be done by means of anti-anopheles measures wherever possible. And in using anti-anopheles measures, we should use to the greatest extent possible the newer naturalistic methods which are effectively applicable to the vector **Anopheles** in the particular area of operations, rather than try to depend, unimaginatively, upon only the dependable old methods of drainage and oiling. Oil also is short and not easily available in many areas. But we are not short on brains, or versatility or constructive imagination or adaptability, and these qualities, with any reasonable quota of technical information should see a resourceful medical officer through some mighty tough spots in this war.

ACTIVITIES IN MEMBER STATES

SOME HIGHLIGHTS OF THE 30TH ANNUAL MEETING N. J. MOSQUITO EXTERMINATION ASSOCIATION

By CHARLES A. DOEHLERT

The following notes, taken from the Proceedings now being set into type, recall some of the statements and discussions that aroused special interest. They do not necessarily represent the most important. No attempt has been made to pass such judgment. The complete facts are to be found in the Proceedings themselves.

L. L. Williams, Jr. pointed out that even the experienced malariol-

ogist cannot set a figure for the population of anopheline carriers which would indicate a malaria hazard. Granted that anopheline and human carriers are present, the seriousness of the hazard depends further upon the screening habits of the human population, their outdoor activity after sundown, the use of killing sprays indoors, and the longevity of the mosquitoes.

G. H. Bradley, in discussing methods of measuring density of **Anopheles quadrimaculatus,** concluded that: "the most satisfactory index to the density of adult **quadrimaculatus** in the South is furnished by the use of natural resting places. Artificial resting places such as boxes and kegs and the use of light traps are of value in obtaining **quadrimaculatus** indices where natural resting places cannot be found. Also, a light trap should always be operated, if possible, in a control area in order to gain an idea of the pest mosquito problem so that explanations of annoyance can be given to the many persons who doubt that **quadrimaculatus** control is efficient merely because annoyance from other mosquitoes continues after **quadrimaculatus** control is achieved."

C. B. Huffaker reported that out of eight methods for trapping mosquitoes, the five least selective (i.e., most likely to reveal the true proportions of each species) gave results corresponding very closely to those attained with the New Jersey trap using no attractant. The author feels that the New Jersey trap without attractant furnishes a means of determining factors by which catches made with other traps can be converted into data more closely representing the actual mosquito population.

L. T. Coggeshall described large-scale intensive malarial infection among military and airline personnel in parts of Africa. By thorough and persistent use of the known control methods, it was demonstrated that malaria could be eliminated. In this region, malaria was the outstanding medical problem of the airline. Without efficient control methods it can bring all activity to a standstill.

Colonel William A. Hardenbergh gave statistics on the control of malaria in the Army:

"The results obtained were good during 1941, when the malaria rate for troops in the continental United States was 1.8 per 1,000 per year. This compared with 2.3 for the 10-year peacetime average, 1931-1940, and with the rate of 7.50 for 1917, which in some ways was a comparable year, so far as the Army is concerned. In 1942, the malaria rate for troops in the continental United States fell to 0.65 per 1,000 per year—the lowest rate the Army has ever had, in peace or in war. In comparing this rate with the rate for 1917 and 1918, it must be remembered that the civilian malaria rates today are much lower than during World War I—probably about one-third as great. In comparison with the 1931-1940 peacetime rate for the Army, consideration must be given to the fact that a definitely higher proportion of our troops are now stationed in malarial areas.

"Although malaria incidence throughout the country may be at a low ebb, the Army's 1942 rate is the result of careful and conscientious

work on the part of all Army personnel concerned—Service Command and post medical officers, sanitary engineers and entomologists—and of the U. S. Public Health Service, and State and local organizations."

D. P. Curry presented a human-interest record of 25 years' work in directing mosquito control operations at Panama Canal.

R. L. Vannote laid down a general guiding principle for civil control organizations. "Closely associated with mosquito-control work within a reservation is the problem of regional control. It is unusual when the two can be divorced. Therefore, the problem of control becomes complicated as to organization and finance as one party can seldom perform both functions. . . . It seems wise to permit the Federal agencies to administer the functions of finance, detail engineering, employment, and detail supervision of personnel and equipment. In this way the broader functions of the job are administered by those most capable of meeting the requirements of organization, which in war time often plays a part equal in importance to the work accomplished. As a rule, I think our county mosquito-control units have felt the job was entirely theirs; that is, on approval of a general plan, funds would be provided to permit the local unit to engage or receive men and equipment from Federal sources and then proceed to perform the work outlined in the general plan as they would a county-financed program. Unfortunately, the military and other Federal agencies are not geared to such a procedure. . . . Therefore, it would seem that the local or county mosquito-control unit has one major function to perform, that is, preparing the master plan of work necessary within the reservation and in the marginal ring. This function should be insisted upon because maintenance becomes a county obligation after the emergency. When this plan has been prepared and accepted by those responsible for the financing and operation, the work should be pursued under the general advice, approval, and over-all supervision of the county unit."

H. H. Stage stated that investigators in the Bureau of Entomology and Plant Quarantine have produced a larvicide "completely effective against anopheline larvae for several days when applied at the rate of 0.1 pound per acre of water surface." Three repellent materials were selected out of more than 700 as effective for several hours under field conditions involving heat and rain. Variation in repugnance to different insects and different species of the same insect was recorded. The identity of the materials has not been revealed because of military reasons. **Culex tarsalis Coq.** was found to be an important vector of sleeping sickness in man and animals.

It is impossible to summarize briefly the review of literature compiled by Bishopp and Stage. The information under a single subheading will be quoted here for its own value and as an indicator to new mosquito workers of the way in which this review of world-wide mosquito work is prepared.

Encephalitis. "A series of four papers on mosquitoes and encephalitis in the Yakima Valley, Wash., appeared in volume 70, number 3, of the Journal of Infectious Diseases. The first paper, by W. McD. Hammon,

W. C. Reeves, B. Brookman, and E. M. Izumi, is entitled "Arthropods Tested and Recovery of Western Equine and St. Louis Viruses from **Culex tarsalis** Coq." During the four-month period, May 15-Sept. 15, 1941, they report collecting over 15,000 living arthropods for inoculating laboratory animals for the purpose of virus isolation. Of these over 12,000 were mosquitoes. From **Culex tarsalis** mosquitoes only, three strains of St. Louis encephalitis virus and five strains of western equine encephalomyelitis virus were isolated. During the 41 days when all the infested mosquitoes were caught, at least one of every 386 **C. tarsalis** was infested.

"The second paper, by W. McD. Hammon, W. C. Reeves, and E. M. Izumi, discussed methods of obtaining suitable live specimens and identification of certain arthropods for virus isolation. Centrifugation of suspensions at 16,000-18,000 r.p.m in an angle centrifuge was found most satisfactory in preparing an inoculum from arthropod specimens. For the isolation of both viruses an intracerebral inoculation of five Swiss mice was proved more satisfactory than an inoculation of one guinea pig or two chick embryos.

"Precipitin tests demonstrated that **Culex tarsalis** feeds in nature on cattle, horses, man, swine, dogs, chickens, and sheep. This information was reported in the third paper, which was by Frederick Bang and W. C. Reeves.

"The last paper, by W. McD. Hammon, W. C. Reeves, B. Brookman, and C. M. Gjullin, summarized the case against **Culex tarsalis** as a vector of the St. Louis and western equine viruses. From the evidence reviewed it seems probable that this mosquito has been the most important vector of western equine and St. Louis encephalitis viruses in the Yakima Valley.

"W. C. Reeves, W. McD. Hammon, and E. M. Izumi were successful, in three out of four experiments, in transmitting St. Louis encephalitis virus by feeding **Culex pipiens** on a 10-percent brain suspension of the virus in 5-percent sheep serum infusion broth mixed with equal parts of whole defibrinated rabbit blood.

"In a paper entitled "**Culex tarsalis** a Proven Vector of St. Louis Encephalitis" (Proc. Soc. Exp. Biol. and Med., Oct. 1942), W. McD. Hammon and W. C. Reeves conclude that this mosquito has been demonstrated to be infected in nature with virus of the St. Louis strain and to be capable of transmitting it. Furthermore, this species fits well into the epidemiological picture encountered in the Yakima Valley, Wash. This is the first instance, they say, in which a mosquito has fulfilled these three criteria for incrimination as a vector in respect to St. Louis encephalitis virus. **Culex coronator** Beyer was also determined as a transmitter in the laboratory. Their experiments also demonstrated that the chicken may serve as a satisfactory reservoir of virus."

T. D. Mulhern reviewed the general, statewide mosquito conditions for 1943 and those conditions of particular importance in individual counties. The year's trapping record involving 89 standard New Jersey

light traps shows a total of more than 400,000 identified mosquitoes. Special mention, supported by trap records, is made of the very successful mosquito control maintained by Fort Dix.

R. J. VanDerwerker reviewed the methods available for handling peak-load breeding. Spraying with larvicide has been found inadequate in North Jersey for peak-load control, even in a year (1936) when there was only one peak-load. It becomes necessary to map in advance the areas and depressions which cause breeding only during prolonged wet periods, so that they may be attacked swiftly in peak-load times. The periods of the year which are especially suitable for this mapping are pointed out. In addition to this, it is necessary to have a "master-plan" for a long time ahead so that all opportunities may be utilized to eliminate permanently these peak-load breeding spots. Flood control and the disadvantages of diked marshes were also discussed.

With a witty introduction that will be remembered by many as one of the bright spots of the session, Mrs. Palmer M. Way presented the viewpoint of the New Jersey Women's Clubs. An up-to-the-minute remark was, "Today when the subject of hours of lost manpower is uppermost, isn't it fitting to consider that in the Victory Garden of 1943, in many places in New Jersey, many an hour of manpower will be lost due to the invading hordes of **Aedes sollicitans** or **sylvestris**?"

A history of mosquito control in Middlesex County (New Jersey) by Tiedjens, Smith, and Thom reveals a number of interesting facts not the least of which is, "In 1920, over two hundred cases of malaria occurred in New Brunswick." [At that time New Brunswick had a population of 32,779.—Ed.]

T. J. Headlee summarized ten years of trapping records with the following conclusions:

"1. **Aedes sollicitans, Culex pipiens** and **Aedes vexans** compose 90.1% of the total number of mosquitoes trapped in the ten year period.

"2. Production of **sollicitans** on the salt marshes of northeastern New Jersey has been reduced to so low a point that this species is a relatively unimportant member of the northeastern New Jersey mosquito fauna.

"3. **Sollicitans** continues from Monmouth County south to be the most numerous species.

"4. **Pipiens** is the outstanding species in northeastern New Jersey wherever population wastes are present in concentrations. It is reduced wherever special attention has been given to it and it shows large and sometimes greatly increased numbers wherever gauges have been set adjacent to waters polluted with human wastes.

"5. **Vexans** is the flood water mosquito in New Jersey. Wherever flood water conditions exist during the appropriate summer season this species occurs in large numbers.

"6. **Anopheles quadrimaculatus** is not a comparatively numerous species within this State but it is sporadically present throughout. There are special favorable conditions for its breeding and it occurs in such

spots in comparatively large numbers. As a pest mosquito it is unimportant but as a vector of malaria its importance is great.

"7. The rest of the species which were trapped, amounting to 27, occur sporadically in various parts of the State but most of them occur in their greatest number in the northeastern section of New Jersey. Behind this factor of distribution lies the difference between clay soils and sandy soils. The clay soils of northern New Jersey, under heavy rainfall conditions, offer a very wide variety of breeding places and consequently propagate a wide variety of mosquitoes. The sandy soils of southern New Jersey, by reason of their ready absorption of rainfall, provide a much more limited and more uniform set of breeding conditions and consequently the number of mosquito species produced under these conditions is reduced."

J. M. Ginsburg described various methods and apparatus for producing and applying aerosol sprays, in killing and repelling adult mosquitoes as well as other insects. The chemical and physical properties of aerosols in general were discussed from a practical viewpoint.

The session was attended by a total of 125 mosquito workers of which 33 were from the military and Public Health Service personnel. Judging from comments heard here and there, this year's meeting was considered particularly interesting and informative. It is anticipated that the complete Proceedings will be mailed out during the month of June.

DEVELOPMENTS IN MOSQUITO CONTROL

THE APPLICATION OF INSECTICIDE DUSTS BY EXPLOSIVES

Should Be Useful Also in Mosquito and Malaria Control Work

By R. D. GLASGOW, Ph.D., State Entomologist,
and ROBERT BLAIR, Collaborator,
New York State Museum, Albany, N. Y.

Experiments here reported, which were originally undertaken to explore the possibility of finding a more economical method of treating mature forest areas with insecticides, as for gypsy moth control, have produced results which may have significance for the war effort and otherwise as a mosquito and malaria control procedure.

Forest Spraying is Difficult and Expensive

Spraying the forest trees and undergrowth thoroughly with an arsenical insecticide has been an accepted method of suppressing gypsy moth colonies which appear in forested areas of the barrier zone. High-power spray outfits are employed which are capable of maintaining a pressure of 1000 pounds per square inch, or sufficient pressure to reach the tops of the tallest trees.

Such an outfit is stationed near an adequate water supply, and heavy, one inch, high pressure hose is laid down leading into the forest, sometimes as far as two miles; whereupon with lateral leads the forest is sprayed thoroughly for some distance on each side as the hose is withdrawn section by section toward the power plant. By repeating this process, the infested forest area is covered strip by strip. Such spraying operations are difficult and expensive; the cost having been estimated to

be in the neighborhood of $10.00 per acre.

Hitherto Available Alternatives Impracticable

Much of the barrier zone is mountainous, with airplane landing fields usually few and remote. For these reasons, airplane dusting would be extra hazardous if not physically impracticable.

No commercial power duster operating from the ground could reach the tree tops, even if it were not excluded by the vegetation and the topography.

So much for the general problem.

Experimental Dusting by Explosives

When he first approached the senior author with the general idea, Mr. Blair had already carried on some experiments with the dispersal of insecticide dusts from near the surface of the ground, by means of an explosive charge embedded in a package of the insecticide. This however had proved unsatisfactory, because it resulted in an undesirably and wastefully heavy application near the center of dispersion.

A manufacturer of fireworks, whose services were enlisted in order to have the benefit of his explosives permit, reported that some years before he had made a number of experimental insecticide bombs for a California customer. These, however, appear to have consisted of an explosive bomb designed to be fired from a mortar, and timed to explode at a predetermined height. They appear thus to have been prohibitively complicated and expensive.

Working at once for simplification and for adaptation to appropriate insect control requirements, it was soon found to be quite sufficient to fire a loose charge of the insecticide dust directly from a suitable mortar on the ground; the height reached by the charge of insecticide and the character of its dispersion in the air being determined by the dimensions of the mortar, the quantity of insecticide, the method of loading, and the kind and quantity of explosive used.

Various kinds of mortars, and charges in many combinations have been tried. A mortar six inches in diameter and 18 inches deep fired the charge too high and too compactly for good nearby coverage; and even when filled with earth to a 12-inch depth, this mortar still gave excessive drive. A heavy, rolled paper, fireworks mortar 8 inches in diameter and 10 inches deep gave excellent lift and mushrooming, but appeared to have a too large capacity for the best control of coverage when used in batteries.

The experimental mortar last used was a 4-inch gas pipe nipple, 4-inches long and threaded at both ends, with one end closed by a threaded 4-inch pipe cap.

This mortar was charged in the following manner:

1. A 3-ounce charge of "Grade A, 4F" rifle powder was placed on the bottom of the mortar.

2. A suitable length of fuse was added, one end placed in the powder and the other end allowed to trail over the edge from the open end of the mortar.

THE APPLICATION OF INSECTICIDE DUSTS BY EXPLOSIVES

Shots Fired at Approximately One Second Intervals

Dispersion After Approximately Three Minutes

3. A disk of heavy cardboard was then placed over the powder and the inner end of the fuse.

4. A 15-inch square of heavy kraft paper was next placed in the mortar so as to rest smoothly on the cardboard disk at the bottom, and carefully folded at the sides so as to line the mortar smoothly and project some inches above the top.

5. The charge of insecticide (about three pounds) was finally placed in the mortar within the paper lining, the paper neatly folded over the top, the fuse coiled above and, with a bit of crushed paper to hold everything in place, the charge was enclosed by a second threaded 4-inch pipe cap lightly screwed on as a cover to make the whole secure and safe.

Without the paper lining, the drag of the insecticide dust against the sides of the mortar will interfere with the proper lift and mushrooming of the charge.

With such a charge in such a mortar, a lift and mushrooming at a height of more than 100 feet is easily obtained; and in our tests excellent coverage was obtained at distances much greater than 100 feet from the mortar. When the dust is carried by a light breeze, good coverage has been observed at distances up to 200 yards and more.

Preferred Designs

The iron mortars last described, while excellent for experimental work, are heavy and relatively expensive. Because of their cost, they

Some of The Experimental Mortars Used

must be retrieved after use; and their weight adds to the cost of operation when they are placed and gathered up.

In practice, it would be best to use a rolled and cemented paper mortar that would be lighter and cheaper, and so not worth recovering. The bottom, of course, should be so attached that it will hold against the thrust of the explosion. The built-up wall need be only about 3 16 to ¼-inch thick.

Dimensions of mortars, quantities of insecticide dusts required, and the nature and quantities of explosives to be used, should be worked out in collaboration by an entomologist and an expert in ballistics to meet different special requirements as they are encountered or foreseen.

Avoidance of Fire Hazard

The use of untreated paper and cardboard would constitute an unnecessary fire hazard. This can easily be avoided by the use of a non-smoldering fuse, and by using only cardboard and paper which have been infiltrated with a high melting, fireproof, chlorinated hydrocarbon such as the chlorinated napthalene "halowax" and the like, or otherwise made fire safe.

Contemplated Method of Use

In a forest that is to be dusted, for example, the charged mortars should be placed the day before. Each unit should be provided with a suitable waterproof enclosure, and should have a bit of the waterproof fuse projecting.

Then in the early morning while the leaves are still moist, while the air is still, and thus while conditions are most favorable for dusting operations, men would be assigned, each equipped with a blow torch, and one to each row of mortars previously placed. Each man would pass rapidly along his row of mortars, igniting the fuse of each before passing on to the next.

With properly charged mortars of appropriate size placed 105 feet apart or four to an acre, and with correct allowance for wind-drift, any forest area could be thoroughly covered with an insecticide or other dust very quickly, at the most favorable time, and at a very modest cost.

The drive of the explosions will set in motion a complicated system of air currents and eddies which should assure thorough coverage of undergrowth under any ordinary conditions, as well as coverage of both upper and under surfaces of the leaves.

Possible Uses for Malaria Control

Some very important malaria carrying anopheline mosquito species may develop in relatively inaccessible places. For example, those which develop in the small but innumerable accumulations of water retained by some tree inhabiting epiphytes, and those which develop in the often highly inaccessible water of mangrove swamps and the like.

Appropriate adaptations of the method here described might help in solving these and other problems.

With such dusting by means of explosives, mosquito breeding, tree inhabiting epiphytes could easily be reached at any height; and appropriate copper bearing, or other dusts which would be tolerated by neighboring or associated plants, might thus be deposited in the accumu-

lation of mosquito breeding water in concentrations sufficient to destroy the mosquitoes, and possible even to kill the offending, epiphytic plants themselves.

In mangrove swamps and places that are similarly difficult of access, with a series of appropriately designed and placed mortars and with a favoring wind, a rolling fog of an appropriate insecticide dust could be made to cover a very large area in a very few minutes.

Experiments, and experience in other fields have made it seem that the application of insecticide dusts by explosives may have promise of usefulness in mosquito and malaria control, and thus in the war effort.

It seems that a charge of insecticide dust and explosive suitably packed in a light and inexpensive rolled paper waste mortar might easily be worked out, which would be appropriate for this purpose; and this report is offered now in order that any such possibility need not be missed.

FISHPONDS FREQUENTLY FOOL A FELLOW
or
MERE MUSINGS OF A MOSQUITO MAN

By PERRY W. RUTH
Bureau of Mosquito Control, Department Public Welfare,
Norfolk, Virginia

Mrs. America has gone all out for fish pools during the last few years, if our experience in Norfolk is a fair measure of conditions elsewhere. Whether this trend springs from an over-developed "Mother Instinct" which craves some living thing upon which to expend its protective care or whether it is simply due to the blossoming of an aesthetic urge to decorate the landscape, still remains an unrevealed enigma. But whatever underlies the origin of each prepossessing piscatorial paradise, they have become a headache to mosquito control workers here.

There is no denying that a glistening bit of water properly placed in its garden setting of soft colors adds a special ingredient to the loveliness of the surroundings which is most engaging, while the flashing scales of the graceful pets that glide to the pool's edge to accept dainties from the fingers of their mistress create a restful sensibility which is soothing to the mind as well as pleasurable to the eye. Yes, indeed! The amateur landscape gardener is rightfully enthusiastic about his creation.

But, Oh Brother, what a difference a few months can sometimes make! In certain cases this enthusiasm dwindles and a carelessly constructed pool of water becomes no more than a neglected but permanent mud hole which is ideal for infesting an entire neighborhood with a variety of mosquitoes. Or the family moves, in order to be more convenient to a new war job, making way for new tenants or owners who only care for fish on Fridays and have no interest in gardening—landscape or vegetable. So the birth rate in the mosquito population of that block takes a tremendous jump and the complaint clerk at mosquito head-

quarters goes on an overtime payroll—that is, unless our inspectors make use of the sixth sense which they have to develop and give that fish pond an injection of larvacide before its disease becomes infectious.

Again, let us consider the case of the over-enthusiastic nature lover who proceeds on the theory that a successful fish pond must be a cross between an aquatic conservatory and a botanical museum. This misguided agriculturist starts with divers types of lilies, continues with various species of water hyacinths and concludes with the ferns and grasses which reward a complete lack of care with a luxuriant and prolific growth that is almost frightening. In a few months there is hardly room in this pool for the fish which have become too fat and lazy to force their way through the maze of roots and leaves in order to feed on a thriving colony of mosquito larvae. As guardians of the public's health and comfort, we now have to contend with not only a troublesome breeding problem but also with an outraged fish fancier who insists that mosquitoes and fish do not live in the same pond and perhaps winds up her argument with the statement that "the book says so." This situation requires both courage and tact.

Then, finally, there is the properly designed and carefully tended pool, well stocked with fish, clean and tidy, a delight to the eye. A majority of such pools offer no mosquito problem whatever. Yet even they can not be entirely disregarded by a careful inspector for every so often one of these models of perfection will break every rule of biology and disclose the anomaly of gold fish and mosquito larvae living peacefully together in one happy family. Robert Ripley would not be interested because this has happened more than once but why any self respecting gold fish should ever so fail in its lawful duty is no more explainable than the fact that some cats never become mousers. It will always be necessary to train our men to expect the unexpected.

But to put banter aside and get down to cases, the fish pond has become one of our major problems. Our revised files list 744 of them within the city limits as of last summer and undoubtedly that number will be considerably increased by another year. Our records for the season of 1942 tabulate 175 individual breeding samples brought to our field office from fish ponds and of these, 55 or more than 30 per cent were positively identified as **Anopheles Quadrimaculatus.** We also find that a neglected fish pond is a favorite habitat of the **Aedes Aegypti** which is further evidence of its possibilities as a public enemy.

Like other problems, this one must have a solution, but this appears to differ according to the locality. We understand that in certain cities a system of regulation has been put into effect as an ordinance which covers not only the method of original construction but requires proper maintenance by issuing permits which may be revoked. Also, the distribution of certain species of top feeding minnows by a systematic plan seems to have brought very satisfactory results in many cases. Up to the present, however, we have relied principally on education through cooperation with our Garden and Civic Clubs and individual owners. This, of course, in conjunction with constant vigilance on the part of

our entire inspection force. We feel that we are making good progress, but we hope to avoid the fatal mistake of being satisfied with what we are doing. This effusion, if properly intercepted, means that we are open to suggestions.

MINNOWS AS A MEANS OF MOSQUITO CONTROL EXTENDED TO NORTHERN WATERS THROUGH THE DISCOVERY OF A SPORT

By J. LYELL CLARKE, Sanitary Engineer
The Des Plaines Valley Mosquito Abatement District
Lyons, Illinois

Thirty years ago Dr. David Starr Jordan, late president of Stanford University, California, recognized the value of small minnows as a mosquito control measure. He noted the absence of mosquitoes in the coastal marshes of Hawaii teeming with a small minnow called "millions" and began a search for a small native fish of the same type. He sent Hildenbrand and Seal, two of his assistants, in search of such a fish. They found Gambusia affinis in southern waters and Gambusia holdbrookii west of the Rockies. Since that time this little minnow has been used wherever malaria control is carried on. Dr. L. L. Williams, Assistant Surgeon General, U.S.P.H.S., states that Gambusia control is good as far as it goes but it doesn't go far enough to satisfy the requirements of malaria control in the southern states.

In the north, where malaria is less hazardous, the little minnow Gambusia affinis keeps mosquito propagation down to a margin so slim that mosquitoes emerging from a pond well stocked with this minnow are not sufficient to constitute an annoyance problem—thus it is a boon to the garden pool owner; to the landscape architect; and those who desire to conserve water resources in farm ponds, lagoons, marshes and swamps.

Winter freezing in shallow streams and marshes has been the main drawback to their life in northern waters. Its northernmost range is the big muddy river basin of Southern Illinois. Failure has always punctuated attempts to extend its range north of the Mason-Dixon Line until 17 years ago when it was found to withstand the rigors of northern winters in a sheltered garden pond on the estate of Roland D. Whitman, Hill Road, Winnetka. Simply by chance it was thought that this pool met the requirements: seven feet deep at the shaded end and a sunlit shallow grassy feeding area at the other end. This was considered to be an ideal pond and other ponds like this one were chosen elsewhere in the Chicago area as breeding pools. Gambusia minnows were shipped from Carbondale but failed to overwinter. Then minnows were taken from the Whitman pond and transplanted to these same similar breeding pools and thrived. There was no explanation but the mosquito abatement workers accepted the phenomenon and continued to stock new ponds and streams over a period of ten years. Dr. David H. Thompson, Zoologist of the State Department of Fisheries, found Gambusia in the Cook County Forest Preserves ponds and knowing that they should not

be in this region began an investigation to determine how they got there and whether the strain could be continued. Dr. Bronkhill of the Shedd Aquarium found Gambusia in Cook County streams and was likewise puzzled. A year later Dr. Thompson made a preliminary report upon the presence of Gambusia in northern Illinois at a meeting of ichthyologists at the Shedd Aquarium. At this meeting Dr. C. L. Turner of the Northwestern University, a specialist on tropical fish, came to the Des Plaines Valley Mosquito Abatement District to obtain a record of ponds and streams which had been stocked so that he and his students might make further studies of this unusual case. He found Gambusia in abundance and expressed his amazement freely. Being at wits end to account for the hardihood otherwise, he suggested that perhaps the strain taken from the Whitman pond was a sport or mutant and if so it would be well worth while to maintain this particular strain for wider distribution in other northern states.

In order to test their hardihood further Mr. Louis A. Krumholtz, Zoological Assistant, took a supply of the Whitman pond strain to Ann Arbor, Michigan, when he left the Illinois Department to join the staff of the Michigan Department of Conservation.

In 1942 a shipment of 300 Gambusia supposedly "sports" were shipped to Mr. Ralph B. Birks, Superintendent of Parks, Moline, Illinois.

Next month a shipment of the Whitman pond sports will be sent to Mr. George Otis Tapley, Bacteriologist, Director of the Board of Health, Brookline, Mass., who will observe their behavior in the Boston region. Each spring for the past twelve years Mr. Tapley has obtained a shipment of Gambusia from Florida for stocking park lagoons and garden pools but has been unable to carry the Florida strain through the winter. Last fall Mr. Tapley read the Saturday Evening Post story "Skeeter-Beater" by Wm. H. Kelty, which told of a strain of acclimated Gambusia, used in the Des Plaines Valley Mosquito Abatement District. Forthwith he wrote for a shipment of the mutants which he promises to handle with loving care in an attempt to determine if they are really sports!

PUBLISHED ARTICLES OF INTEREST

REFERENCES TO LITERATURE ON MOSQUITOES AND THEIR CONTROL

H. H. STAGE
United States Department of Agriculture
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine

Andrews, Justin, Howard, R. S., Jr., and Turner, E. Archer. 1942. Malaria-control, ditch-lining experience in a South Georgia County. Natl. Malaria Soc. Jour. 1:57-67, 2 tables, 1 map, 1 fig., 1 ref.

Anon. 1942. Control of malaria in Palestine. Britsh Med. Jour. No. 4269, pp.517-518.

Anon 1942. Identification of Common Species of mosquitoes. Quart. Bull. La. State Dept. Health 33(3)24, - chart.

Anon. 1942. Malaria and antimalarials. Current Science (Bangalore) 11(9) :347-350.

Anon. 1942. Malaria—scourge of humanity. New Health (London) 17(10) :3.

Anon. 1942. How malaria spreads. New Health (London) 17 (11) :16.

Anon. 1942. Mosquito fighters of Guayaramerin. The South and world affairs (Chapel Hill, N. C.) 4(10) :6-7 and 14.

Anon. 1942. No mosquitoes wanted. Ill. Health Messenger 14 (1) :3-4.

Anon. 1943. Division of medical science of the National Research Council appoints consultant group on malaria. Amer. Med. Assoc. Jour. 121(6) :439.

Anon. 1943. Further conservation of cinchona bark. Amer. Med. Assoc. Jour. 121(6) :439.

Anon. 1943. Malaria mortality in the southern United States. Jour. Amer. Med. Assoc. 121(10)788-789.

Anon. 1943. The critical antimalarial problem and its solution. Va. Med. Monthly 70(1) :52.

Anon. 1943. The national quinine pool. Amer. Med. Assoc. Jour. 121(6) :434.

Anon. 1943. Treatment of malaria under war conditions. British Medical Jour. No. 4280, pp. 75-76, 4 refs.

Bang, Frederik, and Simpson, Thomas, 1942. Feeding habits of **Anopheles walkeri** Theobald at Reelfoot Lake, Tennessee. Amer. Jour. Trop. Med. 22(5) :513-516, 4 tables, refs.

Bellamy, R. E. 1942. Observations on the macroscopic species—Identification of larval **Anopheles** in Georgia. Parasitology 28(4) :299-310, 2 tables, 6 ref.

Bishop, Ann. 1943. Variation in gametocyte production in a strain of **Plasmodium relictum** in canaries. Parasitology (London) 35(1-2) :82-87, 2 figs., 1 table, 8 refs.

Brown, H. W. 1942. Human malaria. Natl. Malaria Soc. Jour. 1:133-139, 26 refs.

Bustamante, Miguel E., Kumm, Henry William, and Herrera, Julio Roberto. 1942. Ausencia de fiebre amarilla en el Valle del Usumacinta (Guatemala y Mexico, 1942), Mex. Inst. Salubridad y Enferm. Trop. Rev. 3(4) :255-271, 2 maps, 3 tables, 14 figs., 3 refs.

Carey, Frank, 1943. Nature's Dive bombers problem for army. Mosquitoes, spreading malaria, must be fought many ways. The Sunday Star, Washington, D. C. March 14, B-3, 3 cartoons.

Carpenter, Stanley J., Brackin, Thomas T., Jr., and Ashton, Donald F. 1942. Entomological work during 1941 bearing on the malaria problem. Natl. Malaria Soc. Jour. 1:157-162.

Carr, H. P., and Hill, R. B. 1942. A malaria survey of Cuba. Amer. Jour. Trop. Med. 22(6) :587-607, 15 tables, 1 fig., 18 refs.

Causey, O. R. 1943. A method for the collection, transportation and study of anopheline eggs and adults. Amer. Jour. Top. Med. 23(1) :133-137, 6 figs.

Causey, O. R., Deane, L. M., and Deane, M. P. 1943. Ecology of **Anopheles gambiae** in Brazil. Amer. Jour. Trop. Med. 23(1):73-94, 9 tables, 5 refs.

Causey, O. R., Penido, H. M., and Deane, L. M. 1943. Observations on malaria in the presence and absence of **Anopheles gambiae** in an experimental area (Cumbe) Ceara, Brazil. Amer. Jour. Trop. Med. 23(1): 59-71, 12 tables, 2 refs.

Clark, Herbert C. 1942. Review of recent publications on the prophylaxis and treatment of malaria. Natl. Malaria Soc. Jour. 1:113-124, 34 refs.

David, W. A. L. 1942. The utilization of waste lubricating oil in mosquito larvicides. Bull, Ent. Research 33(4):235-240, 5 tables, 5 refs.

Deane, M. P., and Causey, O. R. 1943. Viability of **Anopheles gambiae** eggs and morphology of unusual types found in Brazil. Amer. Jour. Trop. Med. 23(1):95-103, 5 tables, 6 figs., 5 refs.

DeMeillon, Botha. 1942. New Nematocera from the Ethiopian region. Ent. Soc. South Africa, Jour. 5:87-98, 8 figs.

du Toit, Maria L. 1942. A case of **Plasmodium ovale** infection. South African Med. Jour. 16(9):182, 1 fig.

Ehrenstein, Maximilian. 1942. Modern antimalarials. Amer. Jour. Pharmacy 114(12):456-482, 2 diagrams, 22 refs.

Faust, Ernest Carroll, 1942. American tropical medicine at the crossroads. Pan. Amer. Union. Bol. de la Ofic. Sanit. 21(12):1247-1251.

Faust, Ernest Carroll, and De Bakey, Lois. 1942. Malaria mortality in the southern United States for the year 1940, with supplementary data on malaria in other States. Natl. Malaria Soc. Jour. 1:125-131, 1 table, 2 figs.

Gabaldon, Arnoldo, and Aquilera, Carmen. 1942. Variaciones del color de los anofelinos venezolanos de la subserie **oswaldoi** (Diptera, Culicidae). Proc. Eighth Amer. Sci. Congress. Held in Washington, May 10-18, 1940. Vol. III, Biological Sciences.

Gingrich, Wendell D., and Fillmore, Rollin S. 1942. The antimalarial effect on acranil in birds. Amer. Jour. Hygiene 36(3):276-282, 2 figs., 28 refs.

Goodwin, Melvin H., Jr. 1942. Studies on Artificial resting places of **Anopheles quadrimaculatus** Say. Natl. Malaria Soc. Jour. 1:93-99, 6 tables, 5 refs.

Haddow, A. J. 1942. A note on the predatory larva of the mosquito **Culex (Lutzia) tigripes** Grandpre and Charmoy (Diptera). Roy. Ent. Soc. London, Proc. (Ser. A) 17(7-9):73-74, 1 ref.

Hammon, W. McD. 1943. Encephalitis eastern and western Equine and St. Louis types, as observed in 1941 in Washington, Arizona, New Mexico and Texas. Amer. Med. Assoc. Jour. 121(8):560-564, 4 tables, 41 refs.

Hammon, W. McD., and Reeves, W. C. 1942. **Culex tarsalis** Coq. a proven vector of St. Louis encephalitis. Soc. Exp. Biology and Medicine Proc. 51(1):142-143, 6 refs.

Hart, Capt. Thomas A., and Hart, J. H. 1942. A descriptive study of the pilotaxy of a modal **Culex pipiens** fourth stage larva. Ent. Soc. Amer. Ann. 35(4) :379-386, 3 figs., 1 ref.

Hart, Thomas A. 1942 Corrections (errors and omissions). Ent. Soc. Amer. Ann. 35(4) :478.

Hewitt, R. I., Richardson, A. P., and Seager, L. D. 1942. Observations on untreated infections with **Plasmodium lophurae** in twelve hundred young white pekin ducks. Amer. Jour. Hygiene 36(3) :362-373, 2 tables, 5 figs., 10 refs.

Horsfall, William R. 1942. Biology and control of mosquitoes in the rice area. Ark. Agr. Expt. Sta. Bull. 427. 46 pp. 4 figs., 19 tables, 30 refs.

Hurlbut, Herbert S., and Hewitt, Reginald. 1942. The transmission of **Plasmodium lophurae,** an avian malaria parasite, by **Anopheles quadrimaculatus.** Pub. Health Rpts. 57(50) :1891-1892, 1 table, 4 refs.

Irwin, William H. 1942. The role of certain northern Michigan bog mats in mosquito production. Ecology 23(4) :466-477, 9 tables, 2 figs., 8 refs.

James, Maurice T. 1942. A two-season light trap study of mosquitoes in Colorado. Jour. Econ. Ent. 35(6) :945, 1 table.

Knipling, E. F., Gjullin, C. M., and Yates, W. W. 1943. A new oil-emulsion mosquito-larvicide. U. S. Dept. Agr. Ent. & Plant Quar. E-587, 4 pp., 1 table, 1 ref.

Knowles, Frederick L. 1943. Growth measurements of **Anopheles quadrimaculatus** larvae. U. S. Pub. Health Repts. 58(4) :136-139, 1 fig., 2 tables, 3 refs.

Legwen, W. A., and Howard, R. S., Jr. 1942. The design and application of a new type automatic siphon for malaria control. Natl. Malaria Soc. Jour. 1 :83-92, 5 plates, 10 refs.

Legwen, W. A., and Lenert, Louva G. 1942. Circular joint and concrete form design for precast inverts for malaria-control ditch-lining. Natl. Malaria Soc. Jour. 1 :69-82, 8 plates, 2 refs.

Lever, R. J. A. W. 1942. The malarial mosquito of Melanesia. Fiji Dept. Agr. Agr. Jour. 13(4) :116-117, 14 refs.

Lewis, D. J. 1942. A method of transporting living mosquito larvae. Bull. Ent. Research 33(4) :227-228, 1 fig.

Lewis, D. J. 1942. A new species of **Aedes** (Dept., Culicidae) from Eritrea. Roy. Ent. Soc. London, Proc., Ser. B :11 (11) :165-166, 1 fig.

Lewis, D. J. 1942. The early stages of **Aedes taylori** Edwards and **A. furcifer** Edwards (Dipt., Culicidae). Roy. Ent. Soc. London, Proc. Ser. B.11(10) :153-154, 4 refs.

Lund, Horace O. 1942. Studies on the choice of a medium for oviposition by **Anopheles quadrimaculatus** Say. Natl. Malaria Soc. Jour. 1 :101-111, 3 tables, 2 figs., 2 refs.

Mahaffy, A. F., Smithburn, K. C., Jacobs, H. R., and Gillett, J. D. 1942. Yellow fever in western Uganda. Roy. Soc. Trop. Med. Hyg. Trans. 36(1) :9-20, 1 plate, 8 refs.

Manson-Bahr, Sir. P. H. 1942. Malaria in wartime. British Med. Jour. No. 4267, pp. 461-462.

McCarthy, D. D. 1941. Report of the Zanzibar Research Unit. (Malaria research scheme). 141 pps., 56 figs., 63 tables, 114 refs.

Meythaler, F. 1942. Die therapie der malaria. Muench, Med. Wock. 89(38) :812-818, 12 charts.

Owen, William B. 1942. The biology of **Theobaldia inornata** Williston, in captive colony. Jour. Econ. Ent. 35(6) :903-907, 2 tables, 7 refs.

Purchase, Harvey S. 1942. Turkey malaria. Parasitology (London) 34(3-4) :278-283, 1 table, 9 refs.

Puri, I. M. 1941. Synoptic tables for the identification of the full-grown larvae of the Indian anopheline mosquitoes. [India Med. Dept.] Health Bul. 16, ed. 4, 1-109, 84 figs.

Randall, Raymond. 1942. Equine encephalomyelitis. Army Vet. Bull. 36(3) :157-171, 21 refs.

Rees, Don. M. 1942. Overwintering habits in Utah of **Anopheles maculipennis freeborni** Aitkens (Diptera: Culicidae). Ent. News 53(10) : 282.

Rees, Don. M. 1943. The mosquitoes of Utah. Univ. Utah Bull. 33(7) :1-99, 24 figs., 16 plates, 26 refs.

Reilly, Frank. 1943. Insect repellents: Demand for use by armed forces puts new life into a dead market with promise of post-war expansion. Soap 19(3) :103-105, 121, 1 fig.

Renn, Charles E. 1942. The crushing strength of biological films on natural waters and the spread of larvicidal oils. Natl. Malaria Soc. Jour. 1 :45-55, 1 table, 2 figs., 4 refs.

Rigdon, R. H. 1942. A consideration of the mechanism of death in acute **Plasmodium falciparum** infection; report of a case. Amer. Jour. Hygiene 36(3) :269-275, 18 refs.

Roubaud, E., and Grenier, P. 1942. Quelques observations sur l'aliment des larves de culicides (Facteurs B et substances proteiques). Soc. de Path. Exot. Bul. 35(6-8) :215-219, 1 fig., 3 refs.

Roy, D. N., and Ghosh, S. M. 1942. Further work on the comparative efficacy of different culicifuges under laboratory conditions. Parasitology (London) 34(3-4) :291-294, 1 table, 8 refs.

Rozeboom, L. E. 1942. The mosquitoes of Oklahoma. Okla. Agr. Mech. Col. Tech. Bull. No. T-16, 56 pps., 6 plates, 2 maps, 5 tables, 34 refs.

Russell, Paul F., and Nenow, M. Kumara. 1942. A malaria-economic survey in rural South India. Indian Med. Gaz. 77(3) :167-180, 2 figs., 13 refs.

Russell, P. F., and Mohan, B. N. 1942. The immunization of fowls against mosquito-borne **Plasmodium gallinaceum** by injections of serum and of inactivated homologous sporozoites. Jour. Expt. Med. 76(5) :477-495, 13 tables, 1 chart, 12 refs.

Russell, Paul F., and T. Ramachandra Rao. 1942. On relation of mechanical obstruction and shade to ovipositing of **Anopheles culicifacies.** Jour. Exp. Zoology 91(2) :303-329, 8 tables, 6 figs., 10 refs.

Saliternik, Z. 1942. The macroscopic differentiation of anopheline eggs according to their pattern on the surface of water. Bull. Ent. Research 33(4) :221-222, 1 plate.

Sautet, J. 1941. L'anophelisme en Syrie et an Liban dans ses rapports avec le paludisme. Bull. Mus. Nat. Marseille 1:106-129, 2 plates.

Scharff, J. W., and Tweedie, M. W. F. 1942. Malaria and the mud lobster. Roy. Soc. Trop. Med. Hyg. Trans. 36(1) :41-44, 2 figs.

Sebastian, V. O. 1942. On the role of **Etroplus suratensis** (Bloch) and **Etroplus maculatus** (Bloch) in the control of mosquitoes. Bombay Nat. Hist. Soc. Jour. 43(2) :271-273.

Sierra, Roberts Benites. 1942. Nuestro enemigo el **Anopheles.** Rev. Colegio Nacional Vicente Rocafuerte No. 54, pp. 247-267, 4 figs., 4 tables, 14 refs.

Smyly, W. J. 1942. A gynandromorph of **Aedes aegypti, L. (Stegomyia fasciata),** Diptera. Roy. Ent. Soc. London. Proc. Ser. A. 17(10-12) :111-112, 1 illus., 4 refs.

Soper, Fred L. 1942. Febre amarela Pan Americana, 1938 a 1942. Pan. Amer. Union. Bol. de la Ofic. Sanit. 21(12) :1207-1222. (English abstract, 1251-1252.)

Soper, Fred L., and Wilson, D. Bruce. 1942. Species eradication. A practical goal of species reduction in the control of mosquito-borne disease. Natl. Malaria Soc. Jour. 1:5-24, 1 table, 1 fig., 13 refs.

Stein, C. D., Lotze, J. C., and Mott, L. O. 1943. Evidence of transmission of inapparent (subclinical) form of equine infectious anemia by mosquitoes **(Psorophora columbiae),** and by injection of the virus in extremely high dilution. Amer. Vet. Med. Assoc. Jour. 102 (792) :163-169, 2 charts, 1 plate, 1 fig., 2 graphs, 2 refs.

Swartzwelder, J. C. 1942. A review of recent work on the parasitology of simian malarial infections and simian plasmodia. Natl. Malaria Soc. Jour. 1:141-147, 25 refs.

Sweet, W. C., Feng, L. C., Chow, C. Y., and Hsu, S. C. 1942. Anophelines of southwestern Yunnan and their relation to malaria. Natl. Malaria Soc. Jour. 1:25-32, 4 tables, 9 refs.

Townsend, Charles H. T., 1942. Note on Amazonian **Nyssorhynchus** races (Dipt.). Rev. de Entomologia 13(1-2) :150-151.

Trager, William. 1942. A strain of the mosquito **Aedes aegypti** selected for susceptibility to the avian malaria parasite **Plasmodium lophurae.** Jour. Parasitology 28(6) :457-465, 2 tables, 23 refs.

Vargas, Getulio. 1941. Regula o regime de combate a malaria en todo o pais. Inspetoria Federal de obras Contra as Secas Boletim. (Rio de Janeiro) 16(2) :140-145.

Vargas, Luis. 1941 **Aedes (Ochlerotatus) rozeboomi** nueva especie (Dipt. Culicidae). Gaceta Medica de Mex. 71(3) :393-395, 8 refs.

Vargas, Luis. 1941. Nota sobre los huevecillos de **Anopheles** mexicanos. Gaceta Medica de Mex. 71(1) :107-123, 12 illus., 3 tables, 18 refs.

Vargas, Luis. 1942. El huevo de **Anopheles barberi** Coquillet, 1903. Mex. Inst. Salubridad y Enferm. Trop. Rev. 3(4) :329-331, 1 fig., 4 refs.

Vargas, Luis. 1942. Nota sobre la validez de **Psorophora (Psorophora) virescens** Dyar y Knab, 1906. Medicina (Mex.) 22(407) :81-84, 2 figs., 5 refs.

Wales, H. G. Quaritch. 1943. Malaria and war in the Pacific. Hygeia 21(2) :102-103, 154-155.

Wats, R. C., and Bharucha, K. H. 1941. The choice of mechanical sprayers for mosquitocides sprayed for anti-malarial purposes. Haffkine Inst., Bombay, Ann. Rpt. 1939. 54-55.

Watson, Sir Malcolm. 1942. The geographical aspects of malaria. Geographical Jour. 99(4) :161-170, 2 figs.

Watson, Robert Briggs, Maher, Helen C., and Rice, Margaret E. 1942. Observations on malaria around Lake Wilson, 1934-1941. Natl. Malaria Soc. Jour. 1:33-44, 5 tables, 2 figs., 1 ref.

Weyer, F. 1941. Die afrikanischen malariaubertrager. Deut. Tropenmed. Ztschr. 45(4) :112-118.

Weyer, F. 1942. Beitrag Zur stechmucken fauna von Mazedonien und Westthrazien. Deut. Tropenmed, Ztschr. 46(11) :284-293, 3 tables, 3 figs., refs. (Available U. S. Dept. Agr. lib. for film 81 Roll 297.)

White, Norman. 1942. The treatment of malaria. Trop. Diseases Bull. 39(12) :801-806, 4 refs.

Young, Martin D. 1942. A review of recent work in avian malaria. Natl. Malaria Soc. Jour. 1:149-156, 60 refs.

Zulueta, Julian de, 1942. **Plasmodium ovale** en Columbia. Rev. Facul. de Med. (Bogota). 10(7) :487-502, 2 plates.

SCIENCE IN 1943

From Science Magazine
February 26, 1943
"The Influence of Biotin Upon Susceptibility to Malaria."
By William Trager
The Rockefeller Institute for
Medical Research
Princeton, N. J.

From Science Magazine
Marsh 19, 1943
Page 8 (Science News)
"The Probable Spread of Tropical Diseases."

From Science Magazine
April 2, 1943
Page 296
A short review on discoveries pertaining to malaria by Military surgeons.

From Science Magazine
April 9, 1943
Page 10
"The Search for an Antimalaria Chemical" as discussed in talk by Colonel Paul F. Russell of the Medical Department of the U. S. Army.

From the American Journal
of Public Health
March, 1943

"Mosquito Vectors and Inapparent Animal Reservoirs of St. Louis and Western Equine Encephalitis Viruses."

By W. McD. Hammon, M.D., Dr.P.H., W. C. Reeves, and M. Gray of the George Williams Hooper Foundation for Medical Research, University of California, San Francisco, Calif.

From the New York Herald
Tribune
April 4, 1943

"Chemists Upset Foe's Blockade of Vital Supply," a discussion by John J. O'Neill on the use of drugs other than quinine for malaria treatments.

From the Engineering News-Record
Feb. 11, 1943

"Sanitation in Latin America," by Gordon M. Fair, Professor of Sanitary Engineering, Harvard University and Consultant to the Division of Public Health and Sanitation, Office of Inter-American Affairs.

PUBLIC HEALTH REPORTS

U. S. Public Health Service

March 26, 1943

Aqueous-Base Yellow Fever Vaccine—by

M. V. Hargett, Surgeon
H. W. Burgess, Assoc. Techn.
Anthony Donovan, Past Asst. Surgeon,
U. S. Public Health Service

February 5, 1943

The Microclimate of Diurnal Resting Places of Anopheles Quadrimaculatus Say in the Vicinity of Reelfoot Lake—by

Don E. Eyles, Assoc. Biologist
Lindsay K. Biship, Scientific Assistant
U. S. Public Health Service

"Some Responses of the Malaria Mosquito to Light"—by

William R. Horsfall, in which he discusses the influence of the general light conditions prevailing during the night upon the catches of the malaria mosquitoes in the New Jersey trap. This article was published in "Annals of the Entomological Society of America" for March, 1943.

ADDITIONAL REFERENCES

H. H. Stage, U. S. Dept. of Agriculture
Washington, D. C.

It has been stated that malaria causes 1,000,000 deaths in India each year. (Taken from the Indian Medical Gazette. Calcutta. Vo. 77, No. 5, May 1942.)

NEW BOOKS

The anopheline larvae of India, Ceylon and Malaya. Practical Notes on their collection with 12 plates, quarto cloth, with supplement. By C. Strickland and K. L. Choudhury.
Price Rs 6

A short key to both sexes of the Anopheline species of India, Ceylon and Malaya. By C. Strickland, Prof. of Med. Ent. School of Tropical Medicine. Calcutta.
Price Rs 1-12

Both of these books are obtainable from Thacker Sprink, Calcutta, India, and other booksellers.

"A Practical Entomological Course for Students of Malariology"
By I. M. Puri

3rd ed. Calcutta, Government of India Press 1942, 189 pages (Health bulletin No. 18, Malaria Bureau No. 9).

A text which includes lectures with diagrams of structure of mosquitoes, (larvae and pupae, adults) practical laboratory and field work suggestions connected with malaria surveys and control measures.

PERSONAL NOTES

Thirty-seven professional entomologists are now commissioned in the U. S. Public Health Service Reserve Corps on the Malaria Control in War Areas program that is being conducted by that Service for the control of malaria vectors in the vicinity of war establishments in sixteen southern states, California, Oregon and Puerto Rico.

In the Senior grade, corresponding to Lt. Colonel are George H. Bradley and Stanley E. Freeborn, both stationed at Atlanta, Ga.

In the Past Assistant grade (Captain) are

William C. Frohne.....Chicago
Newell E. Good.....Washington, D. C.
John A. Rowe.....Kansas City, Missouri
Robert L. Usinger.....Savannah, Georgia

In the Assistant grade (First Lieutenant) are

Walter C. Baker.....Corpus Christi, Texas
Ralph C. Barnes.....Jacksonville, Florida
Leslie Beadle.....Atlanta, Georgia
William E. Bickley.....Norfolk, Virginia
John F. Brandenberg.....Malvern, Kansas
Bernard Brookman.....Berkeley, California
Donald G. Denning.....New Orleans, Louisiana
Wilbur H. Duncan.....Charleston, S. C.
Don E. Eyles.....Kansas State Board of Health
Richard W. Fay.....Jefferson City, Missouri
Roy F. Fritz.....Atlanta, Georgia
Eugene J. Gerberg.....Atlanta, Georgia
Charles F. Gerlach.....Springfield, Illinois
Melvin E. Griffith.....Oklahoma City, Oklahoma
Bertram Gross.....Key West, Florida
Phillip H. Harden.....New Orleans, Louisiana
Newton Hardman.....Marysville, California
Joe K. Neel.....Louisville, Kentucky
H. Page Nicholson.....Norfolk, Virginia
Louis J. Ogden.....Austin, Texas
Allan G. Peterson.....Jackson, Mississippi
Harry D. Pratt.....San Juan, P. R.
A. Earl Pritchard.....San Juan, P. R.
Stuart C. Schell.....Elizabeth City, N. C.
Herbert F. Schoof.....Raleigh, N. C.
Harvey I. Scudder.....Panama City, Florida
Robert E. Serfling.....Louisville, Kentucky
Arthur Shlaifer.....Nashville, Tennessee
C. Arlie Wilson.....Little Rock, Arkansas
Willis W. Wirth.....Alexandria, Louisiana
John W. Zukel.....Alexandria, Louisiana

H. S. McConnell, who has been Associate Entomologist in Maryland for many years, has entered the Sanitary Corps as First Lieutenant. Mr. McConnell served as 2nd Lt. in the Medical Corps during the last war, both in this country and overseas.

Major Stearns, formerly of Delaware, is now located in Iran on malaria control work. Censorship was relaxed somewhat so that he was able to tell of his whereabouts and mentioned the names of some of the towns in his district. Some of these we were able to find on the map so that we know that he is located in the western part of the country near the border of Iraq. He mentions that he has just made a survey of the area, and is training groups for control work. He mentions further that the contrast of the ancient and the modern is very interesting. 1941 automobiles may be seen on streets with medieval types of conveyances. With temperatures of 130 degrees F. expected for the summer, he will be having a "hot" time of it.

Donald MacCreary, Lt. (Sr.Gr.) with the Navy, formerly of Delaware, is now in South America. He has been unable to supply very much information regarding his whereabouts or his activities. However, we know that he is engaged in some sort of malaria work.

A third former member of the Department, Lt. Roger Pierpont, formerly of Delaware, has likewise been shipped abroad to points unknown. He is likewise in malaria control work.

Earl D. Potter, formerly of New Jersey, was transferred to the Sanitary Corps of the U. S. Army and the last we heard, had left the country for foreign service.

Dr. W. V. King, formerly in Florida, is now Colonel in the Sanitary Corps of the U. S. Army and stationed somewhere in the South Pacific. With his knowledge and experience with malaria in that area, we are sure malaria will be much less troublesome to our fighting men wherever Colonel King is located.

DIRECTORY OF AGENCIES ENGAGED IN MOSQUITO WORK

Although an effort has been made to make this directory as complete and accurate as possible, it may be found to contain some errors and omissions. It will be appreciated if readers finding such errors will report them to the secretary, for reference in preparing later directories.

ALABAMA

State Board of Health, Dr. J. L. Baker, Montgomery, Ala.
Montgomery Dept. of Public Health, Bur. of Sanitation, Attn. Miss Roslyn W. Stephens, Montgomery, Ala.
Tennessee Valley Authority: (See also Tennessee)
Mr. Robert L. Crowell, Entomologist, Wilson Dam, Ala.
Mr. C. D. Fairer, Res. San. Engr., Decatur, Ala.
Mr. E. H. Givhan, Res. San. Engr., Scottsboro, Ala.
Mr. T. F. Hall, Botanist, Wilson Dam, Ala.
Dr. A. D. Hess, Head of Biology Section, Wilson Dam, Ala.
Mr. C. C. Kiker, Sr. San. Engr., Wilson Dam, Ala.
Mr. C. W. Kruse, Res. San. Engr., Wilson Dam, Ala.
Mr. Robert L. Metcalf, Entomologist, Wilson Dam, Ala.
Mr. E. A. Philen, Asst. San. Engr., Wilson Dam, Ala.
U. S. Army, Huntsville Arsenal Station Hospital, Lt. C. L. Campbell, Huntsville Arsenal, Ala.

ARGENTINA

The Rockefeller Foundation, Dr. Lewis W. Hackett, Paseo Colon 285, Buenos Aires, Argentina.

ARKANSAS

State Agri. Exp. Sta., Dr. Dwight Isley, Entomologist, Fayetteville, Ark.
State Board of Health, Walter A. Reiman, Chief San. Engr., and A. E. Wilson, Entomologist, Little Rock, Ark.

AUSTRALIA

Council for Scientific & Industrial Research, Div. of Econ. Entomology, L. M. Willings, Box 109, Canberra City, F.C.T., Australia.
University of Queensland, Biol. Dept., R. Hamlyn Harris, Brisbane, Australia.
The University, School of Public Health and Tropical Medicine, Harvey Sutton, Dir., Sidney, Australia.

BERMUDA

Medical and Health Dept., Henry Wilkinson, Sr. Medical Officer, Hamilton, Bermuda.

BRAZIL

Inst. Oswaldo Cruz, Prof. C. J. Rohr, Rio de Janeiro, Brazil.
The Rockefeller Foundation, Dr. R. M. Taylor, Caixa Postal 49, Rio de Janeiro, Brazil.

CALIFORNIA

Alameda Co. Mosquito Abatement Dist., Harold F. Gray, Engr., Oakland, Calif.
Anderson Mosquito Abatement Dist., G. G. Mitchell, Pres., Anderson, Calif.
California Mosquito Control Assn., E. Chester Robinson, Sec.-Treas., 409 Maze Blvd., Modesto, Calif.
California State Dept. of Public Health, Bur. of San. Engineering, C. G. Gillespie, Chief, Shattuck Square Bldg., Berkeley, Calif.
Carpinteria Pest Abatement Dist., F. W. Thomas, Supt., Carpinteria, Calif.
Clear Creek Mosquito Abatement Dist., G. E. Oakes, Sec., Redding, Calif.
Compton Mosq. Abatement Dist., E. Spurlock, Sec. & Supt., 801 E. Main St., Compton, Calif.
Contra Costa Co. Mosq. Abatement Dist., No. 1, Ernest Campbell, Supt., P. O. Box 447, Martinez, Calif.
Cottonwood Mosq. Abatement Dist., Otto Trautz, Sec., Cottonwood, Calif.
Delta Mosq. Abatement Dist., W. P. Menefee, Supt., Visalia, Calif.

Dr. Morris Mosq. Abatement Dist., Fred L. Hayes, Supt., Bakersfield, Calif.
Durham Mosq. Abatement Dist., F. M. Butler, Supt., Durham, Calif.
East Side Mosq. Abatement Dist., E. Chester Robinson, Supt., 409 Maze Blvd., Modesto, Calif.
Fresno Mosq. Abatement Dist., R. G. Pirie, Supt., P. O. Box 2, Fresno, Calif.
Fairoaks Mosq. Abatement Dist., Dr E. N. Buffum, Fairoaks, Calif.
Lassen Junior College, Entom. Dept., A. T. Peterson, Susanville, Calif.
Los Angeles City-County Health Dept., Los Angeles, Calif.
Los Molinos Mosq. Abatement Dist., Ivan V. Mattoon, Supt., Los Molinos, Calif.
Marin Co. Mosq. Abatement Dist., George S. Jones, Sec., Court House, San Rafael, Calif.
Matadero Mosq. Abatement Dist., Gordon W. Mapes, Supt., 310 University Ave., Palo Alto, Calif.
Merced Mosq. Abatement Dist., Harold Lilley, Supt., Merced, Calif.
Napa Co. Mosq. Abatement Dist., A. M. Emerick, Supt., Post Office Bldg, Napa, Calif.
Oroville Mosq. Abatement Dist., W. B. Hengy, Pres., Oroville, Calif.
Pine Grove Mosq. Abatement Dist., M. D. Nicholson, Supt., McArthur, Calif.
Pulgas Mosq. Abatement Dist., Frank T. Gainer, Supt., 363 Oak Grove Ave., Menlo Park, Calif.
Redding Mosq. Abatement Dist., Orion W. Murphy, Supt., Golden Eagle Hotel, Redding, Calif.
Sacramento City Dept. of Health, Herbert F. True, M.D., City Health Officer, Sacramento, Calif.
Solano Co. Mosq. Abatement Dist., H. C. Pangborn, Supt., Suisun, Calif.
Sonoma Mosq. Abatement Dist., J. Andireux, Supt., Sonoma, Calif.
Three Cities Mosq. Abatement Dist., C. C. Pittard, Supt., 317 North Claremont St., San Mateo, Calif.
Univ. of Cal., Div. of Entomology and Parasitology, Dr. W. B. Herms, Chief, Berkeley, Calif.
U. S. Army—Camp Roberts, 77th Sta. Hosp., Motescue T. Moree, Sanitation Officer, Camp Roberts, Calif.
Visalia Mosq. Abatement Dist., Percy A. Menefee, Supt., Visalia, Calif.
West Side Mosq. Abatement Dist., R. H. Coburn, Supt., 214 Buchanan St., Taft, Calif.

CANADA

Banff National Park, The Resident Engineer, Banff, Alberta, Canada.
Canada Dept. of Agr., Dr. Leonard S. McLaine, Dominion Entomologist, Ottawa, Canada.
Canada Fed. Dist. Comm., Allan K. Hay, Consulting Eng., Ottawa, Ontario, Canada.
Dominion Entomological Lab., R. Glendenning, Agassiz, B. C., Canada.
Dominion Entomological Lab., R. P. Gorham, Fredericton, N. B., Canada.
Dominion Entomological Lab., Dr. K. M. King, Saskatoon, Sask., Canada.
Dominion Entomological Lab., G. Allen Mail, Kamloops, B. C., Canada.
Dominion Entomological Lab., Dr. G. M. Stirrett, Chatham, Ont., Canada.
Mr. Frank Gover, Orillia, Ont., Canada.
Minaki Lodge, The Manager, Minaki Lodge, Ont., Canada.
Pictou Lodge, Mr. McKay, Pictou Lodge, N. S., Canada.
Prince Edward Island Nat. Park, The Superintendent, Dalvay House, P.E.I., Canada.
Univ. of Saskatchewan, Dr. J. G. Rempel, Saskatoon, Sask., Canada.
Winnipeg Anti-Mosq. Control Campaign, Dr. H. M. Speechley, Winnipeg, Man., Canada.
Winnipeg Board of Trade, J. McLintock, Winnipeg, Man., Canada.

CANAL ZONE (See also Panama)

Pan American Sanitary Bureau, Dr. John R. Murdock, Box 3002, Balboa, Canal Zone.

The Panama Canal.
Chief Health Officer, M. C. Stayer, Brig. Gen., M.C., U.S.A., Balboa Heights, Canal Zone.
Supervising San. Insp., Charles L. Pierce, Major, Ancon Sanitary Office, Ancon, Canal Zone.
U. S. Army, Panama Canal Department.
Dept. Surgeon, Col. . . . Sherwood, M.C., U.S.A., Quarry Heights, Canal Zone.
Dept Inspector, Col. Wesley Cox, Quarry Heights, Canal Zone.
Dept. Inspector, Mr. J. B. Shropshire, Chief San. Inspector, Quarry Heights, Canal Zone.
U. S. Army, Sixth Air Force.
Dept. Surgeon, Col. Walter Carlson, M.C., U.S.A., and Lt. Col. Burt Held, M.C., U.S.A., Albrook Field, Canal Zone.
U. S. Public Health Service.
Malaria Reasearch Lab., W. H. W. Komp, Sr. San. Engr., Box 5029, Ancon, Canal Zone.

COLUMBIA

Institute Lleras, Dr. Luis Patino Camargo, Bogota, Columbia, S.A.

CONNECTICUT

State Agri. Exp. Sta., Dr. Roger B. Friend, Entomologist, New Haven, Conn.
State Bd. of Mosq. Control, R. C. Botsford, Agent, New Haven, Conn.
State Dept. of Health, Frederick O. A. Almquist, Sr. San. Engr., Hartford, Conn.
Greenwich Dept. of Health, Jerry Cotrone, Town Hall, Greenwich, Conn.
Yale University School of Medicine, M. A. Pond, New Haven, Conn.

COSTA RICA

Pan American Highway, U. S. Engineers Office, Mr. Jason Berry, Eng. in Charge, Apartado 2025, San Jose, Costa Rica.

CUBA

Dr. Henry P. Carr, Apartado 157, Havana, Cuba.
Comision Panamericana de Cooperacion Intermunicipal, Dr. Carlos M. Moran, Obispo 351, Dpto 604, La Habana, Cuba.
The Rockefeller Foundation, Dr. Porter J. Crawford, Apartado 1710, Havana, Cuba.

DELAWARE

State Highway Dept. Mosq. Control Div., Mr. E. E. Lynch, Lewes, Del.
Univ. of Delaware, Entomology Dept., Dr. Paul L. Rice, and Dr. Carl B. Huffaker, Newark, Del.
U. S. Army.
Fort Dupont Sta. Hosp., The Surgeon, Fort Dupont, Del.
Fort Miles Sta. Hosp., The Surgeon, Fort Miles, Del.

DISTRICT OF COLUMBIA (See also U. S. Govt.)

Pan American Sanitary Bureau, Mrs. S. B. O'Leary, Librarian, Wash., D. C.

ENGLAND

British Mosq. Control Inst., Dr. John F. Marshall, Hayling Island, Hampshire, England.
Imperial Inst. of Entomology, Attn. C. J. Golledge, 41 Queens Gate, London, S.W. 7, England.
London School of Hyg. and Trop. Medicine Library, Cyril C. Barnard, Librarian, Keppel St., London, W.C. 1, England.
The Science Museum, The Director, South Kensington, London, S.W. 7, Eng.

FLORIDA

Broward Co. Anti-Mosq. Dist., Fred H. Stutz, Director, Court House, Ft. Lauderdale, Fla.
Dade Co. Anti-Mosq. Dist., Fred H. Stutz, Director, Court House, Miama, Fla.
Escambia Co. Health Dept., Pensacola, Fla.
Florida Anti-Mosq. Assn., Mr. A. C. Newman, Sec., Jacksonville, Fla.

State Board of Health, Dr. John E. Elmendorf, Jr., Dir., Bureau of Malaria Control, and John Miller, Chief Engineer, Jacksonville, Fla.
National Malaria Soc., Mark F. Boyd, Sec., P. O. Box 997, Tallahassee, Fla.
Pinellas Co. Anti-Mosq. Dist., Claude Strickland, Supt., St. Petersburg, Fla.
The Rockefeller Foundation, Mark F. Boyd, M.D., P. O. Box 977, Tallahassee, Fla.
Saint Lucie Co. Anti-Mosq. Dist., Norman G. Platts, Director, Fort Pierce, Fla.
U.S.D.A., Bur. of Entomology and Plant Quarantine.
Mr. W. G. Bruce, New Smyrna, Fla.
Mr. S. W. Simmons, Panama City, Fla.
Dr. B. V. Travis, P. O. Box 3391, Orlando, Fla.
U. S. Army. Camp Carrabelle Station Hospital, 4th Service Command, Manlio A. Manzelli, 1st Lt., Sn.C., Camp Carrabelle, Fla.
Volusia County Anti-Mosquito District, Daytona, Fla.

GEORGIA

Augusta-Richmond County Health Dept., Augusta, Ga.
Chatham County Commissioners, Savannah, Ga.
Columbus-Muscogee County Health Dept., Columbus, Ga.
Crisp County Health Dept., Cordele, Ga.
Crisp Co. Power Commission, E. S. Killebrew, Chief Engr., Cordele, Ga.
Dougherty County Health Dept., Albany, Ga.
Georgia Light and Power Co., C. W. Warner, Gen. Mgr., Valdosta, Ga.
Georgia Power Co., B. W. Sinclair, Supt. of Production, Atlanta, Ga.
Georgia State Dept. of Public Health.
L. M. Clarkson, Director, Sanitary Engineering, Augusta, Ga.
Harold R. Dodge, Entomologist, Macon, Ga.
W. E. Legwin, San. Engineer, Macon, Ga.
Louva G. Lenert, Assoc. Engr., Malaria Control, Atlanta, Ga.
J. Allen Scott, Sc.D., Assoc. Dir., Div. of Malaria and Hookworm Service, Atlanta, Ga.
Glynn County Health Dept., Brunswick, Ga.
Sumpter County Health Dept., Americus, Ga.
U.S.D.A., Bureau of Entomology and Plant Quarantine.
Dr. Carrol N. Smith, Box 78, Savannah, Ga.
Oliver I. Snapp, Entomologist, Fort Valley, Ga.
Valdosta City, Attn. Dr. E. D. King, Jr., Valdosta, Ga.

HAITI

Service du Controle de la Malaria, Port au Prince, Haiti, Leon Dalencour, Civil and San. Engineer.

HAWAII

Hawaii Board of Health, F. K. Lee, Director, Rat and Mosquito Control, Honolulu, T. H.

ILLINOIS

Cairo Mosq. Abatement Dist., Donald A. Miller, President, 801 Washington Ave., and Mrs. Roy White, Secretary, 528 25th St., Cairo, Ill.
Carbondale Mosq. Abatement Dist., Hunt Mitchell, Secretary, Carbondale, Ill.
City of Centralia, Mosquito Control Office, Centralia, Ill.
Chicago Board of Health, Dr. Herman N. Bundesen, Pres., 54 W. Hubbard St., Chicago, Ill.
Chicago Field Museum, Dr. William J. Gerhard, Entomologist, Chicago, Ill.
Chicago Sanitary Dist., Langdon M. Pearse, San. Engineer, and Andy Hall, Hydraulic Engineer, 910 S. Michigan Ave., Chicago, Ill.
Cook County Health Unit, Dr. E. A. Piszczek, Director, 737 So. Wolcott Ave., Chicago, Ill.
Desplaines Valley Mosq. Abatement Dist., J. Lyell Clarke, Superintendent, 8130 Ogden Ave., Lyons, Ill.
Du Page County Health Unit, Dr. John P. Walsh, Wheaton, Ill.
Dupo Mosq. Abatement Dist., Mr. E. J. Schmelzel, Chairman, Dupo, Ill.

Enoz Chemical Company, H. R. Rich, Entomologist, Chicago, Ill.
Herrin Mosq. Abatement Dist., Dr. Frank C. Murrah, Director, Herrin, Ill.
Highland Park Mosq. Abatement Dist., A. M. Laurie, Field Director, Highland Park, Ill.
Illinois Pest Control and Service, Inc., W. K. Delaplane, Jr., Manager, 403 So.
Illini Pest Control and Service, Inc., W. K. Delaplane, Jr., Manager, 403 So. McCullough St., Urbana, Ill.
Illinois Dept. of Public Health, Mr. Clarence W. Klassen, Chief San. Engr., Springfield, Ill.
Lake Forest Mosq. Abatement Dist., Carl G. Lindenmeyer, Supt., Lake Forest, Ill.
North Shore Mosq. Abatement Dist., A. H. Meier, Dir., and Thomas J. Lynch, Supt., P. O. Box 55, Winnetka, Ill.
University of Chicago.
Dr. Francis B. Gordon, Ricketts Laboratory, Chicago, Ill.
Dr. Clayton G. Huff, Prof. of Parasitology, Chicago, Ill.
University of Illinois, Entomology Dept., Dr. C. W. Kearns, Urbana, Ill.
U. S. Army.
Chanute Field Extension Hospital, Maj. H. D. Countryman, M.C., Chief of Med. Service, Chanute Field, Rantoul, Ill.
Granite City Eng. Depot, Lt. S. C. Kaim, Surg., M. C., Granite City, Ill.
Ft. Sheridan San. Dept., Capt. Gilbert, San. Corps, Ft. Sheridan, Ill.
U.S.P.H.S.
District No. 3, Col. L. M. Fisher, San. Engr., 852 U S. Customhouse, Chicago, Ill.
Natural History Survey, Chas. E. Gerlock, Asst. Entomologist, Urbana, Ill.

INDIA

Malaria Institute of India, Attn. Lt. Col. G. Covell, Director, Calcutta, India.

INDIANA

Indiana State Board of Health, Gordon R. Christianson, Asst. San. Engr., (R) U.S.P.H.S., Indianapolis, Ind.

IOWA

Iowa State College of Agriculture, Entomology Dept., Dr. C. J. Drake, Ames, Iowa.

KANSAS

Kansas State College, Prof. Roger C. Smith, Manhattan, Kan.

KENTUCKY

State Board of Health, Bur. of San. Eng., Robert H. Harris, Director, Louisville, Ky.
U. S. Public Health Service, Paducah, Ky.

KENYA

Medical Research Lab., Attn. Medical Entomologist, P. O. Box 141, Nairobi, Kenya, Africa.

LOUISIANA

Freeport Sulphur Co., E. H. Flewellen, New Orleans, La.
State Board of Health.
C. L. Chapman, San. Engr., (R) U.S.P.H.S., Baton Rouge, La.
E. B. Johnson, State Entomologist, Alexandria, La.
L. S. U. Medical Center, Dept. of Tropical Medicine, E. Harold Hinman, New Orleans, La.
New Orleans City Health Dept. Aedes Aegypti Control Unit. (U. S. Public Health Service and State of Louisiana Cooperating.) Harvey S. Ludwig, Ass't San. Eng., 308 Loyola Ave., New Orleans, La.
Tulane University of Louisiana, Dept. of Tropical Medicine, Dr. Ernest Carrol Faust, New Orleans, La.
U.S.P.H.S., District No. 4, Howard L. Grant, P.A. San. Engr. (R), and T. E. McNeel, Entomologist, New Orleans, La.

MARYLAND

Johns Hopkins University, School of Hygiene and Public Health, Dr. M. M. Brooke, Dept. of Parasitology, and Alfred H. Fletcher, Assoc. in San. Eng., 615 No. Wolfe St., Baltimore, Md.

State Dept. of Public Health, Abel Wolman, Chief Engr., 2411 N. Charles St., Baltimore, Md.

University of Maryland, Dr. E. N. Cory, Entomologist, College Park, Md.

U. S. Army, Edgewood Arsenal Headquarters, Service Division, Major Harold L. Anderson, Chief, Edgewood Arsenal, Md.

MASSACHUSETTS

Bristol-South Plymouth Mosq. Cont. Project, James T. Hennessy, Wareham, Mass.

Brookline Division of Fly and Mosquito Cont., George Otis Tapley, Court House, Prospect St., Brookline, Mass.

Cape Cod Mosq. Cont. Project, Lewis E. Weeks, Secretary, Hyannis, Mass.

State Agri. Exper. Sta., Dept. of Entomology and Zoology, Miss E. M. Kiley, Librarian, Amherst, Mass.

State College, Dept. of Entomology and Zoology, G. C. Crampton, Amherst, Mass.

State Dept. of Public Health, Paul J. Jakmauh, M.C., Comm. of Public Health, Boston, Mass.

State Reclamation Board, Edward Wright, Chairman, State House, Boston, Mass.

MEXICO

Escuela N. De Ciencias Biologicas, Dr. Alfons Dampf, Apartdo Postal 7016, Mexico, D. F.

Mexico Departamento de Salub Publica, Salvador Morales y Carvajal, Ing. Const., Campana Paludismo, Mexico, D. F.

Dr. Luis Vargas, Mexico City, Mexico.

MICHIGAN

State College of Agriculture, Entomology Dept., Assoc. Prof. E. J. McDaniel, East Lansing, Michigan.

U. S. Army, Fort Custer Station Hospital, Major R. L. Reynolds, M.C., Fort Custer, Michigan.

MINNESOTA

University of Minnesota, University Farm, Dr. W. A. Riley, St. Paul, Minn.

MISSISSIPPI

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State College, Dept. of Zoology and Entomology, Dr. Clay Lyle, Head, and Dr. Ross E. Hutchins, Assoc. Prof., State College, Miss.

U. S. Engineers, Frank Wood, Vicksburg, Miss.

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University of Missouri, Zoology Dept., Prof. Rudolph Bennit, Columbus, Mo.

U.S.P.H.S., District No. 7, Porter A. Stephens, P.A. San. Engr., and John A. Rowe, P.A. Entomologist, Kansas City, Mo.

MONTANA

U.S.P.H.S., Rocky Mountain Lab., Div. of Infectious Diseases, R. R. Parker, Dir., Hamilton, Mont.

NEW HAMPSHIRE

Agricultural Experiment Station, Prof. W. C. O'Kane, Durham, N. H.

University of New Hampshire, Entomology Dept., Prof. J. G. Conklin, Durham, N. H.

NEW JERSEY

Associated Executives of Mosquito Control Work in New Jersey, Thomas D. Mulhern, Sec., N. J. Agrl. Expt. Station, New Brunswick, N. J.
Atlantic Co. Mosquito Ext. Comm., Fred A. Bailey, Supt., 217 Atlantic Co. Trust Bldg., Atlantic City, N. J.
Bergen Co. Mosquito Ext. Comm., John P. Peterson, Supt., Room 314 Administrative Bldg., Hackensack, N. J.
Cape May Co. Mosq. Ext. Comm., O. W. Lafferty, Cape May Court House, N. J.
Burlington Co. Mosq. Ext. Comm., Charles S. Beckwith, Pemberton, N. J.
Cumberland Co. Mosq. Ext. Comm., Dr. Joseph C. Lamb, Pres., 38 East Commerce St., Bridgeton, N. J.
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Essex Co. Mosq. Ext. Comm., George W. Eager, Jr., Supt., Hall of Records, Room 310, Newark, N. J.
Hudson Co. Mosq. Ext. Comm., L. DeWitt McCarter, Supt., Room 1010, Trust Co. of N. J. Bldg., Jersey City, N. J.
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Mosquito Ext. Assn., Dr. Thomas J. Headlee, Sec., N. J. Agrl. Expt. Sta., New Brunswick, N. J.
State Agricultural Exp. Station, Dr. Thomas J. Headlee, State Entomologist, New Brunswick, N. J.
State Dept. of Health, Dr. J. Lynn Mahaffey, Dir. of Health, Trenton, N. J.
State Federation of Women's Clubs, Mrs. Palmer M. Way, Chairman of Mosq. Control, 2400 Atlantic Ave., North Wildwood, N. J.
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Union Co. Mosq. Ext. Comm., Ralph J. VanDerwerker, Supt., 324 North Ave., East, Cranford, N. J.
U. S. Army.
Delaware Ordnance Depot Station Hospital, Surgeon, Delaware Ordnance Depot, N. J.
Fort Dix Station Hospital, Surgeon, Fort Dix, N. J.
Fort Hancock Station Hospital, Surgeon, Fort Hancock, N. J.
Camp Kilmer Station Hospital, Surgeon, Camp Kilmer, N. J.
Fort Monmouth Station Hospital, Surgeon, Fort Monmouth, N. J.
Picatinny Arsenal Station Hospital, Surgeon, Picatinny Arsenal, N. J.
Raritan Arsenal Station Hospital, Surgeon, Raritan Arsenal, N. J.
Tilton General Hospital, Commanding Officer, Fort Dix, N. J.
U. S. Navy.
Cape May Naval Air Station, Chief Medical Officer, Cape May, N. J.
Lakehurst Naval Air Station, Chief Medical Officer, Lakehurst, N. J.

NEW YORK

The American Museum of Natural History, Dr. C. H. Curran, Central Park West at 79th St., New York, N. Y.
The American Public Health Association, Reginald M. Atwater, Ex. Sec., 1790 Broadway, New York, N. Y.
Brooklyn College, Biology Dept., Prof. George S. Tulloch, Bedford Ave. and Avenue H, Brooklyn, N. Y.

Cinchona Products Inst., Inc., Dr. Norman Taylor, 10 Rockefeller Plaza, New York, N. Y.
Cornell University, Dr. Robert Matheson, Ithaca, N. Y.
Nassau County Mosq. Ext. Comm., Ray H. Sammis, Supt. District No. 1, 75 Lee Ave., Rockville Center, N. Y.
Nassau County Mosq. Ext. Comm., Edward Butchard, Supt. District No. 2, Roslyn Heights, N. Y.
City Dept. of Health, Dr. John L. Rice, Dir., 125 Worth St., New York, N. Y.
City Dept. of Sanitation, Albert J. Lizee, Act. Dep. Comm., 125 Worth St., New York, N. Y.
State Museum, Dr. Robert D. Glasgow, Entomologist, Albany, N. Y.
Rensselaer Polytechnic Institute, E. J. Kilcawley, Prof. of Soil Mechanics and Sanitary Engineering, Troy Bldg., Troy, N. Y.
The Rockefeller Foundation, Information Service, H. B. Van Wesep, Chief, 49 W. 49th St., New York, N. Y.
Suffolk Co. Mosq. Ext. Comm., C. T. Williamson, Supt., Yaphank, L. I., N. Y.
U. S. Army.
Halloran General Hospital, Commanding Officer, Willowbrook, S. I., N. Y.
Mitchel Field Station Hospital, Surgeon, Mitchel Field, N. Y.
Fort Niagara Station Hospital, Surgeon, Fort Niagara, N. Y.
Pine Camp Station Hospital, Surgeon, Pine Camp, N. Y.
Plattsburg Barracks Station Hospital, Surgeon, Plattsburg Barracks, N. Y.
Rhoads General Hospital, Commanding Officer, Utica, N. Y.
Second Service Command Headquarters, Surgeon, Governors Island, N. Y.
Camp Shanks Station Hospital, Surgeon, Camp Shanks, N. Y.
Camp Upton Station Hospital, Surgeon, Camp Upton, N. Y.
Fort Wadsworth Station Hospital, Surgeon, Fort Wadsworth, N. Y.
West Point Station Hospital, Surgeon, West Point, N. Y.
U.S.P.H.S.
District No. 1, Mr. Arthur P. Miller, 15 Pine St., New York, N. Y.
Liason Officer, Second Service Command, Dr. Albert E. Russell, Surgeon's Office, Governors Island, N. Y.

NORTH CAROLINA

State Board of Health.
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University of North Carolina, Sterling Brackett, Asst. Prof. of Public Health, Chapel Hill, N. C.
U. S. Marines. New River Marine Barracks, Malaria Control Officer, Omar J. Brown, Lt. Comdr., U.S.N., New River, N. C.

NORTH DAKOTA

Agricultural College, H. S. Telford, Asst. Entomologist, State College Station, Fargo, N. D.
State Dept. of Health, Dr. Frank J. Hill, Act. Health Officer, Bismarck, N. D.
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State University, Zoology and Entomology Dept., Dr. Alvah H. Peterson, Columbus, Ohio.

OKLAHOMA

State Dept. of Public Health, F. R. Hassler, San. Engr., Oklahoma City, Okla.

OREGON

Portland City-County Mosquito Control District, Mr. Edward G. Gavin, City Insectarian, 3105 N. E. 46 Ave., Portland, Oregon.
U.S.D.A., Bur. of Entomology and Plant Quarantine, C. M. Gjullin, Assoc. Entomologist, 438 U. S. Customhouse, Portland, Ore.

PANAMA (See also Canal Zone)

Gorgas Memorial Lab., Dr. Herbert C. Clark, Dir., Box 1252, Panama, R. de P.

PENNSYLVANIA

Delaware County Agrl. Agent, H. O. Wilcox, Media, Pa.
Delaware Co. Mosq. Ext. Comm., James F. Conner, Exec. Sec., Court House, Media, Pa.
State College, J. O. Pepper, Ext. Entomologist, State College, Pa.
Department of Health, G. A. Elias, Harrisburg, Pa.
Philadelphia Bureau of Highways, Dept. of Public Works, E. A. Doherty, Philadelphia, Pa.
Philadelphia County Agent, Charles K. Hallowell, 409 Custom House, 2nd and Chestnut Sts., Philadelphia, Pa.
Philadelphia Dept. of Public Health, Hubley R. Owen, M.D., Dir., City Hall Annex, Philadelphia, Pa.
Philadelphia Dept. of Health, Division of Housing and San., Herbert M. Packer, Esq., Chief, City Hall Annex, Philadelphia, Pa.
Philadelphia Dept. of Public Works, Hon. John N. Neeson, Dir., City Hall Annex, Philadelphia, Pa.
U. S. Army. Medical Field Service School, Attn. Major Marcus D. Kogel, M.C., Carlisle, Pa.
U. S. Navy. Philadelphia Navy Yard, Capt. E. C. Carr, M.C., U.S.N., Philadelphia, Pa.

PUERTO RICO

U. S. Public Health Service, John M. Henderson, San. Engr., (R), and Harvey D. Pratt, Asst. Entomologist, (R), San Juan, Puerto Rico.

RHODE ISLAND

State College, Dr. Herbert Knutson, Kingston, R. I.
State Dept. of Agriculture and Conservation, Entomology and Plant Industry, Brayton Eddy, Administrator, State House, Providence, R. I.

SAN SALVADOR

Office of Inter-American Affairs, Dr. E. Harold Hinman, San Salvador, El Salvador, Central America.

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U. S. Army.
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Myrtle Beach Bombing Range, Franklin L. Laseter, 1st Lt., C.E. Post Engr., Myrtle Beach, S. C.

TENNESSEE

Dyersburg County Health Unit, Sanitary Engineer, Dyersburg, Tenn.
Howard-Krauss Society, South Side High School, Miss Annekay Thorpe, Sponsor, Memphis, Tenn.
Madison County Health Dept., Robert H. Meade, U.S.P.H.S., Malaria Control in War Areas, Jackson, Tenn.
Memphis City-County Health Dept., Malaria Control Division, M. W. Yates, and H. G. Tuggle, 879 Madison Ave., Memphis, Tenn.
Memphis Kennedy General Hospital, Maj. D. W. Pollard, M.C., Park and Shotwell Aves., Memphis, Tenn.
National Fireworks Co., E. H. Luce, Resident Mgr., Cordova, Tenn.
State Dept. of Public Health, W. C. Williams, M.D., Comm. of Public Health, Nashville, Tenn.
Tennessee Valley Authority. (See also Alabama).
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Mr. C. A. Evans, Res. San. Engr., Knoxville, Tenn.
Mr. F. E. Gartrell, Res. San. Engr., Paris, Tenn.
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Mr. B. R. Simms, Res. San. Engr., Chattanooga, Tenn.
Mr. W. G. Stromquist, Principal San. Engr., Chattanooga, Tenn.
Dr. R. B. Watson, Principal Malariologist, University of Tennessee, Memphis, Tenn.
Trenton County Health Officer, Dr. E. P. Bowerman, Trenton, Tenn.
University of Tennessee, Dr. G. M. Bentley, State Entomologist and Plant Pathologist, Knoxville, Tenn.
University of Tennessee Medical School, Div. of Preventive Medicine, Malaria Research, Dr. F. L. Roberts, and Dr. R. B. Watson, 874 Union Ave., Memphis, Tenn.
U. S. Army.
Chicksaw Ordnance Works, Maj. C. W. Meldrum, Millington, Tenn.
Ferry Command and Air Support Base, N. L. Howell, Asst. San. Engr., Airways Blvd., Memphis, Tenn.
Memphis General Dispensary, Commanding Officer, Quartermaster Depot, Memphis, Tenn.
Headquarters Second Army, Infirmary Special Troops, Joseph M. Spitzer, Major, Memphis, Tenn.
U. S. Navy. Millington Naval Air Station, Lt. Commander R. L. Laemer, Millington, Tenn.
Vanderbilt University, Dr. H. E. Meleney, Nashville, Tenn.

TEXAS

Abilene-Taylor County Health Unit, Dr. Francis E. Dill, Dir., Abilene, Tex.
A. & M. College of Texas, Irving M. Dietz, Instructor, College Station, Tex.
Alice-Jim Wells County Health Unit, Dr. H. H. Puckett, Dir., Alice, Tex.
Bexar County Health Unit, Dr. M. M. Dorbandt, Dir., San Antonio, Tex.
Brazoria County Health Unit, Dr. E. S. Freeman, Dir., Angleton, Tex.
Bryan-Brazos County Health Unit, Dr. T. E. Dodd, Dir., Bryan, Tex.
Brownwood-Brown Co. Health Unit, Dr. C. W. Kelley, Dir., Brownwood, Tex.
Cameron County Health Unit, Dr. Grady Deaton, Dir., and Joe B. Winston, San. Engr., San Benito, Tex.
Cass County Health Unit, Dr. C. H. Benning, Dir., Linden, Tex.
Central Texas Health Dept., (Bell, Coryell, Lampasas, Williamson Counties), Dr. C. M. Covington, Dir., Belton, Tex.
Clarksville Malaria Control Project, Tom Tipping, Supr., Clarksville, Tex.
Corsicana-Navarro Co. Health Unit, Dr. L. A. Proctor, Dir., Corsicana, Tex.
Dallas County Health Unit, Dr. J. M. Pickard, Dir., Dallas, Tex.
Dallas Public Health Dept., Dr. J. M. Dowis, Acting Dir. of Public Health, Dallas, Tex.
El Paso-Hudspeth Co. Health Unit, Dr. W. B. Prothro, Dir., El Paso, Tex.
Five Counties Health Unit, (Yoakum, Terry, Gaines, Dawson, Hockley Counties), Bronwfield, Tex.
Ft. Worth Public Health and Welfare Dept., Dr. H. M. Williams, Acting Dir., Fort Worth, Tex.
Gainesville-Cook County Health Unit, Dr. H. H. Terry, Dir., Gainesville, Tex.
Gulf Health Dept., (Victoria, Wharton, Matagorda, Calhoun, Jackson Counties), Dr. E. S. Freeman, Dir., El Campo, Tex.
Hardin-Tyler County Health Unit, Dr. W. E. Cox, Dir., Woodville, Tex.
Harris County Health Unit, Dr. R. L. Cherry, Dir., Houston, Tex.
Hidalgo County Health Unit.
Dr. Joe W. May, Dir., Edinburg, Tex.
C. R. Tobin, Sr. Engrg. Aide, U.S.P.H.S., Health Center Bldg., Corpus Christi, Tex.
Houston City Health Dept., Dr. Austin E. Hill, Dir., and R. H. Martens, Prin. Engrg. Aide, U.S.P.H.S., Houston, Tex.
Hunt County Health Unit, Dr. Ralph Jenks, Dir., Greenville, Tex.
Jasper-Newton County Health Unit, Dr. R. S. Lloyd, Dir., Jasper, Tex.
Jefferson County Health Unit, Dr. L. P. Walter, Dir., Port Neches, Tex.

McKinney-Collin County Health Unit, Dr. W. L. Kitchens, Dir., McKinney, Tex.
Midland-Ector County Health Unit, Midland, Tex.
Milam-Robertson County Health Unit, Dr. T. E. Crump, Dir., Cameron, Tex.
Nueces-Kleberg Co. Health Unit, Dr. E. W. Prothro, Dir., Corpus Christi, Tex.
Orange City-County Health Unit, Dr. L. P. Walter, Dir., Orange, Tex.
Palo Pinto-Parker County Health Unit, Dr. Geo. G. Howard, Dir., Mineral Wells, Tex.
Paris-Lamar County Health Unit, Dr. W. F. Draper, Dir., Paris, Tex.
Rice Institute, Asa C. Chandler, Special Consultant, Malaria Control in War Areas, Houston, Tex.
San Antonio City Health Dept., Dr. W. A. King, Dir. of Public Health, San Antonio, Tex.
San Augustine Co. Health Unit, Dr. John Schreiber, Dir., San Augustine, Tex.
Southwestern Texas Health Unit, (Uvalde, Zavala, Kinney, Maverick Counties), Dr. Paul G. Capps, Dir., Uvalde, Tex.
Sweetwater-Nolan Co. Health Unit, Dr. Francis E. Dill, Dir., Sweetwater, Tex.
Tarrant County Health Unit, Dr. W. B. Nies, Dir., Fort Worth, Tex.
Texarkana-Bowie Co. Health Unit, Dr. C. H. Benning, Dir., Texarkana, Tex.
Texas State Dept. of Health, Dr. S. W. Bohls, and L. J. Trotti, Asst. State Dir., Malaria Control in War Areas, U.S.P.H.S., Austin, Tex.
Travis-Basthrop Co. Health Unit, Dr. J. M. Coleman, Dir., Austin, Tex.
Tyler-Smith Co. Health Unit, Dr. H. C. Wilson, Dir., Tyler, Tex.
Upshur Co. Health Unit, Dr. W. R. Ross, Dir., Gilmer, Tex.
U.S.D.A., Bureau of Entomology and Plant Quarantine, Dr. Ernest W. Laake, Box 208, Dallas, Tex.
U. S. Army.
Camp Barkeley Div. of Sanitation, Hdqrs. O.C.S., M.R.T.C., Everett C. Handorff, 1st Lt., Sn.C., Camp Barkeley, Tex.
Camp Normoyle, Surgeon, Magnus J. Myres, Lt. Col., M.C., San Antonio, Tex.
Fort Sam Houston, Office of the Sanitary Inspector, Conrad W. Christenson, Ist Lt., Sn.C., Fort Sam Houston, Tex.
Sheppard Field Hdqrs, Irving M. Dietz, San. Engr., Sheppard Field, Tex.
U. S. Navy. Corpus Christi Air Station, Wm. M. Gordon, Lt., H-V(S) U.S.N.R., Entomologist, c/o Central Dispensary, Corpus Christi, Tex.
Waco-McLennan Co. Health Unit, Dr. Paul L. Wermer, Dir., Waco, Tex.
Wichita Falls-Wichita Co. Health Unit, Dr. Lewis C. Robbins, Dir., Wichita Falls, Tex.

TRINIDAD

The Rockefeller Foundation, Mr. Raymond C. Shannon, Box 556, Port of Spain, Trinidad.
U. S. Navy, Air Station, Lt. W. K. Lawlor, Port of Spain, Trinidad.

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U. S. Dept. of Agri., Bur. of Entomology and Plant Quarantine.
Dr. F. C. Bishopp, Asst. Chief of Bureau, Washington, D. C.
H. H. Stage, Sr. Entomolgist, Div. of Insects Affecting Man and Animals, Washington, D. C.
Orlando, Fla.
New Smyrna Beach, Fla.
Fort Valley, Ga.
Savannah, Ga.
438 U. S. Courthouse, Portland, Ore.

U. S. Army.
The Surgeon General, Washington, D. C.
Wm. A. Hardenbergh, Col., San Corps, Office of the Surgeon General, Washington, D. C.
Paul F. Russel, Lt. Col., Med. Corps, Chief, Malaria Control Section, Washington, D. C.
Col. James S. Simmons, Army Medical Center, Washington, D. C.
Hdq. First Service Command, Chief, Med. Branch, Supply and Services Division, 808 Commonwealth Ave., Boston, Mass.
Hdq. Second Service Command, Chief, Med. Branch, Supply and Services Division, Governors Island, N. Y.
Hdq. Third Service Command, Chief, Med. Branch, Supply and Services Division, U. S. Post Office, Baltimore, Md.
Hdq. Fourth Service Command, Chief, Med. Branch, Supply and Services Division, Atlanta, Ga.
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U. S. Navy.
The Surgeon General, Navy Bldg., Washington, D. C.
Bureau of Yards and Docks, Mr. B. Lenhart, Washington, D. C.
U. S. National Museum, Dr. Alan Stone, Washington, D. C.
U. S. Public Health Service.
The Surgeon General, Washington, D. C.
Malaria Control in War Areas, Dr. L. L. Williams, Jr., 605 Volunteer Bldg., Atlanta, Ga.
Malaria Investigations, J. L. Robertson, Jr., San. Engr., 874 Union Ave., Memphis, Tenn.
The National Institute of Health, The Director, Bethesda, Md.

UTAH

Salt Lake City Mosq. Abatement Dist., Robert A. Wilkins, Supervisor, 401 City & County Bldg., Salt Lake City, Utah.
University of Utah, Dr. Don M. Rees, Salt Lake City, Utah.
State Agricultural College, George F. Knowlton, Logan, Utah.
State Board of Health, State Capital Bldg., Salt Lake City, Utah.

VERMONT

State Agricultural Experiment Station, Dr. J. L. Hills, Burlington, Vt.

VIRGINIA

Norfolk Dept. of Public Welfare, Perry W. Ruth, Supt., Mosquito Control, Norfolk, Va.
U. S. Navy.
Naval Construction Center, Chief Mosquito Control Officer, J. G. Ware, Capt., U.S.N., Commanding, Camp Peary, Williamsburg, Va.
Naval Operating and Air Base, Chief Mosq. Cont. Officer, Norfolk, Va.
State Agricultural Experiment Station, V.P.I. Agricultural Branch Library, Miss Lucy Lee Lancaster, Assoc. Libarian, Blacksburg, Va.
State Dept. of Health, R. E. Dorer, Dir., Malaria Control, 300 Essex Bldg., Norfolk, Va.

VENEZUELA

Arnoldo Gabaldon, Division De Malariologia, Apartado Postal 1509, Caracas, Venezuela.
Arturo Luis Berti, Division De Malariologia, Maracay, Venezuela.

WISCONSIN

State Board of Health, L. F. Warrick, State San. Engineer, State Office Bldg., Madison, Wis.

INDIAN MOSQUITO PUMPS

for

MOSQUITO CONTROL WORKERS

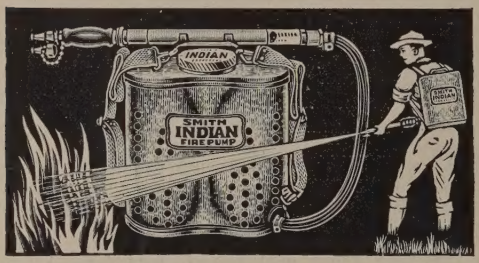

FIG. 1

Fig. 1. SMITH INDIAN MOSQUITO PUMP is a 5-gallon galvanized tank equipped with a double action pump and ADJUSTABLE NOZZLE. The large fill opening on top of tank has a non-leaking fill cap. All hose and washers are furnished with Oil Resisting rubber on request. This outfit has a minimum of movable parts to wear or break, and with the above features, makes it the ideal sprayer for both oil and pyrethrum larvicide spraying.

Fig. 2. Illustrates the ease in which the tank may be carried by hand, filled in the field and the manner in which the pack-back type sprayer is slung on the back, leaving the arms free to direct the spray or adjust the nozzle for long distance or fog mist.

FIG. 2

WRITE FOR CATALOG

D. B. SMITH COMPANY

UTICA, NEW YORK